OLUME 11 1935 NUMBER 2

ECONOMIC GEOGRAPHY

APRIL

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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Dr. Dicken, an earlier contributor to ECONOMIC GEOGRAPHY (see issue, January, 1932, *Dry Farming in the San Joaquin*), won his doctorate from the University of California in 1930. He is now instructor in the department of geography, University of Minnesota. His field of research the last two or three summers has been eastern Mexico.

Dr. Landon, assistant professor of economics and economic geography at Duke University, obtained his A.B. and M.A. degrees at the University of Kansas. Majoring in economics, with a minor in economic geography, he received his Ph.D. degree from the University of Illinois in 1926. Since that time he has been on the staff at Duke University, giving considerable time to research on the tobacco and cotton growing industries of the southern states, and to silk and coffee production in Latin America and the Caribbean countries, respectively.

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(Indexes of ECONOMIC GEOGRAPHY *are issued every October for the volume just completed. The articles of the magazine are also indexed in the International Index to Periodicals to be found in every United States Library.)*

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Published Quarterly by

CLARK UNIVERSITY, at 10 Ferry Street, Concord, N. H.

Editorial Office, Clark University, Worcester, Massachusetts

PRICE, $1.50 THE CURRENT NUMBER

FIVE DOLLARS A YEAR
(except to charter subscribers)

Entered as second class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879

THE PACIFIC

SIGNIFICANT in the future affairs of the nations beyond our utmost vision today, the mighty Pacific already intrudes its influence into the plans, the activities, the economies, the cultures of the countries of the world wherever they may be. No land is so remote, no nation so detached, that it does not feel in some wise and in some measure the impulse of the surging seas and seething peoples of the Pacific. No solution of the world's social and political problems is possible now without due regard for the Pacific as a factor.

Long a sea of mystery, and rare and precious products, the Pacific has now become one of the world's well-known highways, yielding not only the treasure of its pearl fisheries, its spice-gardens, and its tea-plantations, but such simple and necessary, though prosaic, produce from its fields and pastures as grain from its paddies and dry plains and plateaus; butter and cheese from its pastures; lumber from its forests; fish from its shoals and tributary rivers; and fertilizer from its lonely islands.

The lordly salmon of the Columbia, the Alaskan streams, the Siberian rivers; the halibut of the offshore coastal waters; the shark and the whale of the ocean wastes—all these the world receives from the resources of the Pacific. The nitrates of the South American deserts, the teak of the Farther Indian forests, the sugar of the Philippine plantations, the tin and rubber of Malay, the quinine of Java—these and a thousand others enter into the world's trade.

The galleons of Spain, the sloops of Arabia, the barks of Portugal, the clipper-ships of America no longer sail the Pacific, but the great merchant navies of the modern world traverse its waters and grace its ports. The flags of Japan and Britain, of Norway and Holland, of France and America, of Sweden and Germany and Italy, of all the maritime countries of the world, fly orientward in its monsoons, tear to shreds before its typhoons.

The Pacific must be reckoned with. Its wide-flung shores have a part to play in the world's affairs that they will not be denied. What is that part to be?

ECONOMIC GEOGRAPHY

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SALMON INDUSTRY OF THE PACIFIC COAST

Otis W. Freeman

PACIFIC salmon fisheries exceed in value all others on earth except herring and oysters. The natural range of the salmon covers coastal areas and streams in the north Pacific from California to Alaska in North America and Bering Sea to the Amur River in Siberia and islands of northern Japan. Some runs occur on streams tributary to the Arctic.

SPECIES OF PACIFIC SALMON

Five species of salmon *Oncorhynchus* live in coastal waters on both sides of the North Pacific and migrate into fresh water streams for spawning.

1. The chinook or king salmon *O. tschawytscha* attains the largest size and highest value of all species. This fish lives from California to Norton Sound, Alaska, and from northern China probably to the Arctic. Chinook average 22 pounds in weight with a few specimens attaining 80 or 100 pounds. The flesh is a deep salmon red except in a few localities where part of the fish have white flesh. Some rivers have one run of chinook annually, others two, in spring and fall, while the Columbia River enjoys three runs, first from January to March, second and largest in May and June, and the last from late July to early October. Among the sounds and bays of southeast Alaska king salmon have been caught every month of the year because such areas serve as feeding grounds for the fish. The king or chinook salmon spawns from its fourth to its seventh year with females mostly four years of age. The largest fish are the oldest males. Chinook canned salmon commands the best prices on the market. Alaskans mild cure many chinooks. Some are frozen or sold fresh.

2. The sockeye, blueback, or red salmon *O. nerka* in the ocean has a blue color above and silvery below changing in fresh water to red back and sides with a whitish belly. This species furnishes a majority of the canned salmon. The fish average five pounds in weight but attain a length of three feet and weight of 12 pounds. Alaska sockeye run about 7¾ pounds for males and 5½ pounds for females. The Fraser River is famous for runs of sockeye and the bulk of the catch in Puget Sound in American waters comes from fish headed for this Canadian stream. Fraser River sockeye runs reach a high maximum every four years. This run comes the year following leap year with the year after this the smallest run of all. Sockeye runs are important from the Skagit River in Washington to Bering Sea with large catches along Vancouver Island and the Alaska and British Columbia mainland. Some sockeye ascend the Columbia River and small runs occur in Oregon and northern California streams. Only the Kamchatka and Ozernaya rivers in Siberia have important runs of this salmon. Sockeye generally spawn during the fourth year with many males and a

FIGURE 1.—Landing a gill net near the mouth of the Columbia River.

few females waiting until the fifth year. From Puget Sound to Alaska most sockeye runs arrive from mid-July to mid-August with an extreme range of June to October.

3. The humpback or pink salmon *O. gorbuscha,* while the smallest species, supports very important commercial fisheries. Pink salmon vary in weight from 3 to 11 pounds and average around 4 to 5 pounds. The species reaches greatest abundance in southeastern Alaska and is important in central Alaska and British Columbia. The runs in western Alaska are smaller. Puget Sound has a large run every other year. Humpbacks occur as far south as California but are unimportant south of Puget Sound. Great numbers are caught in Kamchatka. In southeast Alaska, humpback runs last from June into September with the maximum catch in July and August. Humpback salmon always spawn in their second year which explains their smaller size.

4. Silver or coho salmon *O. kisutch* have flesh of excellent flavor but pale in color. The fish average 6 pounds with a maximum up to 30 pounds. Coho salmon live from Monterey Bay to Alaska. Most cohoes run later in the season than other species. Since the canned product sells for less because of its light color and the fish is wary of nets it hardly pays to fish for cohoes alone or keep the canneries open only for this species. Hence usually only those cohoes caught with runs of other salmon are canned. Cohoes are most important in the Puget Sound region where in some years more of this species is canned than of any other although in years of big runs both sockeye and pink will exceed the coho pack. Coho when canned, sells under the name of medium-red salmon. Coho salmon spawn normally only in their third year.

5. Dog or chum salmon *O. keta* average about 8 pounds and reach 16 pounds in weight. The flesh is light yellow, especially when canned. Chum salmon are often frozen, salted, or smoked. The species is abundant and chiefly utilized commercially from Puget Sound to southeast Alaska. Large numbers live in east Kamchatka and the Okhotsk regions of Siberia. In central, western Alaska and the Arctic, natives dry this species for winter dog food, hence its name. While chum salmon runs begin in June the height of the season comes in late August and early September in Alaska and even later in Puget Sound and the Columbia River. This is not favorable for their use in canneries many of which close before the chum runs attain importance. Chum salmon may spawn in their third, fourth, or fifth year.

6. The steelhead trout *Salmo gairdneri* is treated like salmon by Pacific fishermen. This fish may weigh over 40

pounds with an average of from 8 to 15 pounds in different regions. The flesh is pale which limits its use by canneries but is of excellent quality for frozen and fresh markets. The fish spawns in streams in the spring arriving later towards the north. Unlike the salmon, steelhead trout do not die after spawning, but may return to the sea and again ascend a river to spawn.

LIFE HISTORY OF PACIFIC SALMON

Practically all Pacific salmon spawn once and thereafter die. Born in the shallows near the headwaters of fresh water streams salmon fry find nourishment from the yolk-sac for a month or two during a time when they mostly hide among the gravel until they grow to about one inch in length. Then shoals of the fry feed on insects and other life in the water until after many months, having attained a length of several inches, they migrate to the sea. During the two to seven years the fish spend in salt water before joining a great run up some stream, salmon live in the ocean within a few miles of the coast. Both king and coho salmon will take the hook during this period of their life in the shallow coastal waters. Salmon voraciously feed mostly on a small shrimp-like crustacean floating in incredible numbers in the Pacific off the shores. At maturity, reached in various species at different ages, salmon enter fresh water streams to spawn. Whether instinct determines the time of their migrations or whether some change in the temperature or salinity of the ocean water produced by glacier fed rivers in flood, gives a stimulus to the fish, or some other unknown cause operates, at any rate the salmon move in vast schools towards the spawning grounds. Probably, since salmon are believed to have lived in the ocean near the mouth of the river down which as fry they migrated, the fish generally, but not always, return to spawn in the stream where they were born. Marked salmon have been caught in other streams than those in which they were liberated but a large majority return to their birthplace.

Once started upstream a salmon either keeps on to the spawning beds or perishes in the attempt. Some dominant, impelling force drives on the migrating fish. Salmon run up rivers in high flood, climb over swift rapids, even "jump" considerable falls. The fish are said not to feed after they enter fresh water, yet several weeks may elapse before salmon arrive at a spawning ground. Traps, nets, and spears of fishermen must be avoided. In fresh water the colors of the fish change, their flesh becomes flabby and unfit for food, skin may be bruised on sharp rocks and

FIGURE 2.—King or Chinook salmon caught with a line at Sitka, Alaska, weighing 62½ lbs. Occasional specimens weigh up to 100 lbs. (Courtesy of Photo Shop, Sitka, Alaska.)

parasitic growths may injure the salmon but still the fish swim on to their destination. At the spawning grounds the female scoops out a shallow hollow in the gravel and deposits her eggs which are fertilized by a male after which gravel is scraped over the eggs by the tail of the female. The life work of the adult Pacific salmon is now over. They lived in order to perpetuate their species. This accomplished they may linger for a while in the stream or float slowly, tail backward, down stream. In either case the salmon, their duty done, soon die from parasites or starvation and their life story is over.

FIGURE 3.—Chinook salmon caught by the gill net near the mouth of the Columbia River. Horses are used in pulling the ends of the net onto the shore.

Trout feed upon salmon eggs and the young fry. Multitudes perish but enough escape to maintain the runs. Once the salmon reach the sea their enemies are probably few and a majority of such salmon likely reach maturity and themselves return to spawn.

DEPLETION AND CONSERVATION OF PACIFIC SALMON

Man has been the chief cause for the depletion of salmon fisheries. Principal factors have been: (1) Overfishing in rivers and ocean, (2) Obstruction by dams, (3) Pollution of spawning streams, (4) Destruction of salmon in irrigation ditches. In addition trout and other fish eat salmon eggs and immature fry. Sea lions, bears, and certain birds consume salmon, but man directly or indirectly causes most of the depletion.

A terrible example of depletion is the Sacramento River from which were packed 200,000 cases of salmon in 1882 followed by a rapid decline to only a few thousand cases per year after 1900. Since 1920 no salmon at all have been packed. The Columbia River attained a maximum production of 634,700 cases in 1895. Salmon fisheries have been better maintained here and still average from 400,000 to over 500,000 cases per year, but the early completion of the Bonneville and Grand Coulee dams by the United States Government threatens to exterminate the salmon industry on the Columbia worth $10,000,000 yearly. Plans to elevate the fish over the Grand Coulee dam, 250 feet high and to artificially propagate the salmon are not certain to perpetuate this important fishing industry. Coastal streams of Washington, Oregon, and northern California all show great depletion. The catch of sockeye salmon in Puget

Sound and the Fraser River of British Columbia declined from a combined record of 1,357,700 cases in 1913 to 172,300 cases in 1929. Every fourth year comes the biggest sockeye salmon run on the Fraser. The record run since canning started was in 1913 and unfortunately a rock slide made during the construction of a railroad closed the Fraser River channel at Hell's Gate Canyon and millions of fish died without spawning. It was estimated that only one-eighth of the fish reached the spawning grounds. Overfishing might have caused some decrease in the runs but the great damage was done in carelessly closing the river channel during a record salmon run. The problem of conserving Fraser River salmon is difficult since more of the fish that spawn in the Fraser are caught in American Puget Sound waters than in Canadian, yet the breeding grounds are all in British Columbia. Coöperation between the United States and Canada is therefore required.

In spite of all the gear and efforts of the fisherman an indeterminate number of salmon escape to the spawning grounds where they perform the last and most important act of their life. The most efficacious way to conserve salmon fisheries is to insure the continuation of adequate natural spawning. Traps and seines should therefore not continuously operate during the season but should be open long enough to allow the migration of some breeding stock. State and government laws and regulations provide for such periods closed to fishing.

Artificial propagation does considerable good but can hardly be relied upon alone to completely perpetuate the salmon industry. The U. S. Government operates a score of salmon hatcheries in Washington, Oregon, California, and Alaska (the plants in Alaska being closed for the sake of economy in 1933). The state of California operates 4 hatcheries, Oregon 15 and Washington nearly 30. There are a dozen hatcheries in British Columbia operated by Canada and the province. Associations of salmon packers also sponsor a few hatcheries. Nearly fifteen billion fry, mostly of the valuable chinook salmon have been liberated from 1873 to 1934. Results are better when the fish released have reached the size of fingerlings, when they can better escape their predatory enemies like trout.

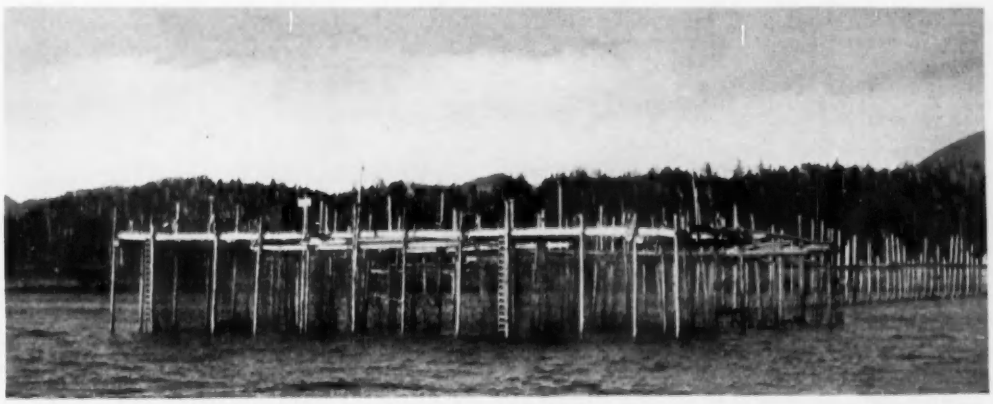

FIGURE 4.—Stationary fish trap at low tide. This is the type commonly used in Puget Sound waters and in Alaska where the bottom permits piles being driven. The barrier at the right conducts the fish into the heart from which they pass into the pot and spillers. (Courtesy of Fisher.)

Fishermen often catch immature salmon on the feeding grounds by trolling and purse seines. These small fish called "graylings" would grow several times their weight at this stage and their capture is an economic waste especially as their flesh is inferior. Oregon forbids possession of such fish and catching immature salmon for market should be forbidden everywhere.

Sewage and waste from sawmills and other manufacturing plants may injure streams for spawning since salmon require pure, cold water.

Improperly screened irrigation ditches may allow young salmon to pass along to an early death. Dams should always have fish ladders for the ascent of the salmon. Some dams like Rock Island near Wenatchee on the Columbia River have provided a good fishway but too often such have been omitted.

The conservation of salmon fisheries must provide for adequate natural spawning by regulation of the fishing period and gear used and prevention of obstruction and pollution of rivers by man plus a continuation of artificial propagation and coöperation between all parties interested in the industry for its perpetuation.

FISHING METHODS

Methods used in catching salmon include: gill nets, haul seines, purse seines, floating and stationary traps, fish wheels, trolling, and several other ways of small commercial importance.

Both drift and set gill nets are used. Their length depends upon the width of the river or channel, depth of water, etc. On the Columbia River the nets average about 1,500 feet in length and have a stretch mesh for chinooks of about 9 inches. In British Columbia the usual net is 900 feet long with a mesh of 6 inches. Puget Sound and other areas use lengths and mesh suited to the waterways and salmon species caught. Drift gill nets are best adapted to the estuaries of rivers. The nets are placed in an L shape facing downstream about

FIGURE 5.—Floating fish trap on beach at Todd, Alaska. Towards the water the large heart opens into a smaller which leads into the pot, the middle compartment towards the observer, from which the fish go into the spiller at the corners where they may be brailed out. (Courtesy of Photo Shop.)

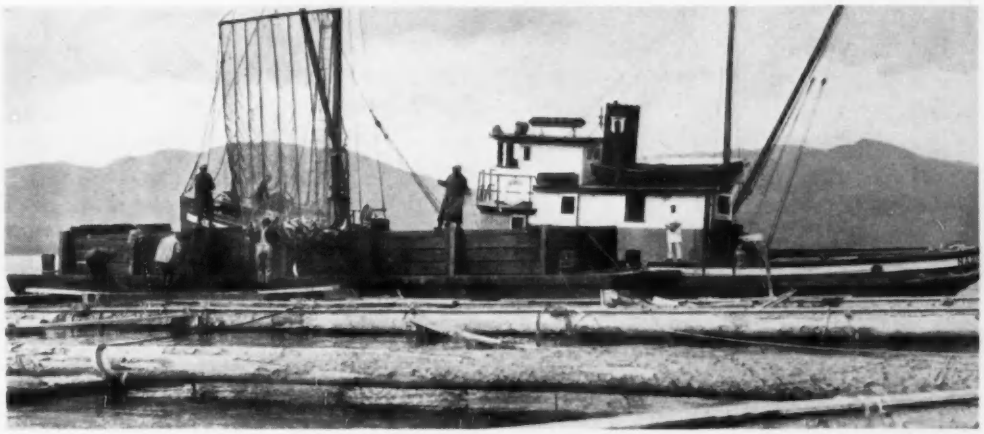

FIGURE 6.—Brailing salmon from a floating trap into a scow along the Alaskan Coast. The brailing net is lowered into the spiller compartment of the trap, slipped underneath the mass of fish therein, and quickly raised to dump the fish into the scow. (Courtesy of Fisher.)

one hour before high tide and left for an hour after the turn of the tide. When the nets are hauled in fish caught by the gills on the cords are killed by a blow on the head and tossed into the bottom of the boat. Set gill nets operate usually in the upper reaches of a river and can extend only part way across the stream.

Haul seines are used especially on the Columbia River, where sand bars and low shores or islands are available for landing the nets. Nets used vary in length from a few hundred feet to half a mile depending on local conditions. The shallow end for use near the shore is about 40 meshes deep increasing to 120–140 meshes on the other wing. The central part of the net is a bag or "bunt" about 300 feet long into which most of the fish collect that are surrounded by the net. A power boat takes the net out in a great semicircle against the current with the shallow end left close to the shore. After the circuit is completed horses haul in the net quickly so that the salmon have little opportunity to escape around the ends of the net, under the lead line on the bottom, or to jump the cork line that floats the net.

The use of set nets and haul seines was forbidden in Washington waters by an initiative measure adopted in November 1934. It will take some time to prove whether this law will benefit the salmon industry.

In deep, swift waters of Puget Sound and southeast Alaska the purse seine is one of the most important fishing methods. These seines have a length of about 1,200 feet and a depth of over 100 feet with a 3¾ inch mesh. On sighting a school of salmon the power boat used for purse seining sets out a dory to which one end of the seine is attached and the dory circles around the school back to the starting point meanwhile laying out the seine. By hauling on both ends of the seine by a power winch the circle is narrowed, and at the same time the bottom of the seine is drawn together like a bag by the purse line which runs through iron rings in the bottom of the net. When the net has been pulled alongside the vessel the fish are in the bunt or "pocket" of the seine from which dip nets easily remove the fish to the hold.

Salmon traps take over half the Alaskan fish catch although the proportion of the entire catch taken by traps declined from 61 per cent in 1930 to 55 per cent

in 1932. In 1933, 520 traps operated in Alaska, but some of these were ordered discontinued in 1934 to allow local residents to catch more fish with other gear. In November, 1934, the voters of the state of Washington adopted an initiative measure prohibiting the operation of salmon traps within that state. Traps took from one-third to over one-half of the Puget Sound catch, but an increase in purse seines is expected to maintain the catch.

FIGURE 7.—Purse Seine fishing for salmon in Alaska.

Traps may be either floating or fixed permanently. Stationary traps consist of piles connected with wood stringers that hold wire netting or webbing in position. First constructed is a barrier or "lead" of stakes or floating logs holding wire or net webbing in place from the bottom to above water level. Since fish tend to swim in a given course and rarely reverse themselves, the salmon deflected by the lead pass into the trap itself. First are the V-shaped "hearts," usually two in number, the larger of which may be 30–60 feet across, opening into a smaller which in turn leads into a square "pot" through the "tunnel." On either side of the pot are other square compartments called "spillers" which store the fish that enter through tunnels from the pot. Fish are lifted into boats or scows, from the spiller by a net apron called the "brailer" operated by a power capstan. Many tons of salmon can be quickly loaded in this way. Men hand sort and return to the ocean species of trapped fish not wanted. Where tidal reversal of currents occur double traps may be constructed to catch salmon on both incoming and outgoing tides. Traps are located near stream mouths and on points where salmon closely approach the shore. In Alaska floating traps made of logs 18 inches to 2 feet in diameter bolted solidly together with similar arrangements to the fixed traps above described are preferred. Many sites are impractical for driving-piles and some difficulty has been experienced in securing lasting permits to use traps. Floating traps have a barrier of nets fastened to an underwater framework of iron rods that descend 30 feet below the surface. Wire netting is generally used for trap construction, some 60 rolls being required for each trap. Fish traps may cost several thousand dollars apiece.

On the Columbia wooden weirs, locally called traps, really a modification of devices used by Indians, catch small quantities of fish.

Fish wheels, operated by the current, were used exclusively on the Columbia River. Some worked from a scow and others from a fixed location along the shore. Nets attached to the revolving wheel dipped out salmon and dumped them into bins. Few fish wheels operated in recent years and their catch was small. The use of fish wheels is now forbidden by Washington state laws.

Trolling is used to capture salmon, especially king salmon in Alaska waters. Both rowboats and power trollers are used and a considerable quantity is caught. In Alaska trollers are limited to four lines at one time. Trolling can be carried on much of the year. When canneries close the fish are sold to the fresh markets.

Indians, by treaty, have been allowed to spear and trap salmon at certain rapids, like the Dalles and Kettle Falls on the Columbia, for many years. The Indians secure food this way but the total quantity is insignificant.

FIGURE 8.—Typical troller of the better class used in Puget Sound.

FIGURE 9.—Type of power fishing boat used in Alaska photographed at entrance to Port Armstrong. The box is covered by tarpaulin and filled with king salmon caught by trolling.

THE CANNING PROCESS

Canneries locate on tidewater almost without exception. This conveniently permits both the receipt of fish and the shipment of the canned product by boat. At the cannery fishing boats, or scows loaded at a trap, are unloaded by an elevator that consists of a trough containing an endless chain with cross boards every two feet to hold the fish, which are dumped on the fish floor or into bins. The elevator eliminates hand pitching of the salmon which was hard labor and left holes punched into the fish. Workmen separate the catch into piles or bins for each species with poles ending in a hook or spike called pews. If fish have been in a scow from 18–24 hours, canning proceeds as quickly as possible, otherwise salmon are stored that length of time to allow the fish to shrink which removes any danger of packing light weight cans containing an excess of juice. Before dressing the fish, streams of water play on them to remove dirt and slime.

In canning salmon the machinery arranged on a "line" does the work with economy of time and labor. Formerly salmon were dressed by hand, with Chinese preferred for this labor. Now a machine called the "Iron Chink" does

the work of a score of men. This useful invention was first tried at Bellingham in 1903. Seattle manufactures most of the "Iron Chinks," and much of the other salmon canning machinery. The "Iron Chink" first cuts off head, tail, and fins from the salmon, then two wedge shaped knives scoop out the entrails, stiff brushes remove the scales, and jets of water clean the fish. Men inspect the fish and do any further cleaning required by hand. A machine with revolving gang knives, generally circular

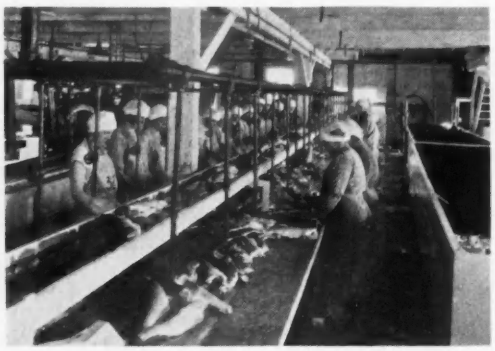

FIGURE 10.—Women inspecting fish from the Iron Chink and completing the cleaning of the fish by hand. The fish next go to the slicing machine and then the sections are forced into cans in the filling machine. The Iron Chink machines in this picture are an old style. These machines remove head and tail, entrails, fins and scales from the fish. (Courtesy of Juleen, Everett, Washington.)

in shape, slices each fish into sections of the length required to fill the cans being then packed. The tail pieces are smaller with less meat and fall to one side. They are canned separately from the head and middle sections and sell for less because of the larger bone content. Some canneries discard the tail piece, which of course is an economic waste since the flesh is good food.

Machines fill the cans with salmon, then seal and cook the containers with a minimum of labor. An endless belt delivers cans to a rotary filling machine that can handle 120 cans per minute. Into each pound can there drops automatically one fourth of an ounce of salt. The salted cans and sections of salmon pass along separate chutes until the chunk of fish passes into a chamber. When the can comes exactly in line a plunger forces the salmon into the container after which the cans pass along an endless belt over a weighing machine. Cans below weight are shunted to one side where workers, equipped with gloves, add the bits of fish needed. Workmen clip off with scissors any bones and excess scraps of fish that stick out of the cans.

The cans next pass through a vacuum closing machine. Here an exhaust pump draws off the air from the cans. Covers with rubber washers already attached are tightly sealed by crimping without the use of solder. The vacuum closing machine did away with a preliminary 15 minute heating in steam to exhaust the air before the final cooking. Naturally this invention saves time, space in the "line", and labor.

After crimping, the cans are placed upright on iron trays or crates about one yard square and generally holding 127 one-pound tall cans. The loaded crates are loaded on trucks and run on miniature tracks into retorts for cooking. This process requires from 90–120 minutes depending on the variety of salmon, size or shape of the cans, and weather conditions. The cooking is done with steam at a temperature of 240° to 245° F. under 10 to 12 pounds pressure. Large boned fish like the king salmon are cooked longest. The high temperatures soften the bones so they become edible. No oil is added to the fish. The juice in a can came from the cooked salmon itself.

On coming from the retort the cans are rinsed with lye to remove grease and washed off with fresh hot water to remove any excess of lye. The iron crates of canned salmon next go to the

cooler room, where a stream of cold water may be played on the cans to prevent the heat inside the cans from continuing to cook the fish. A continuous popping noise from the contraction of the cans accompanies their cooling. Before they have entirely cooled the cans are tested for defects by tapping and slight differences in the sound permit faulty cans to be removed.

To prevent rusting, the cans after cooling for 24 hours or more, run through a bath of quick drying lacquer. By aid of an air blast cans take only two minutes to dry. Some canners no longer lacquer the cans but depend on the label to prevent rusting and use ends already enameled by can manufacturers.

Portable can labeling machines make quick work of coating cans with paste or mucilage. The label becomes attached as the sticky can rolls over a pile of flat labels. A few producers market quality salmon in cans, lithographed on the metal, that open with a key attached to the can.

The cans are packed in cardboard cases containing 48 one-pound tins or 96 half-pound cans. The cardboard is cheaper than wooden boxes formerly used that cost about 10 cents apiece knocked down.

Some canneries buy their cans ready made, but especially in Alaska, where all supplies are brought in by boat, the manufactured cans occupy too much space to permit the importation in addition to food stuffs and other supplies. Furthermore, cans can be made by part of a crew while the rest are getting the machinery, traps, and other essentials ready for the canning season. Several weeks may be spent in manufacturing the required cans from sheet tin for the season's pack. Many canneries, especially in Alaska, import the soldered cylinders for cans pressed flat. Along with the ends, the flattened cans come packed into the same cardboard cases used for canned salmon. Such cases find reuse for packing filled cans. A machine seams out the flattened tins by suction, crimps on one end with a double seam and delivers the cans to an endless belt for carrying to the filling machine. The receipt of flattened tins finds favor in some plants because a whole crew is not needed at the start of the season, a

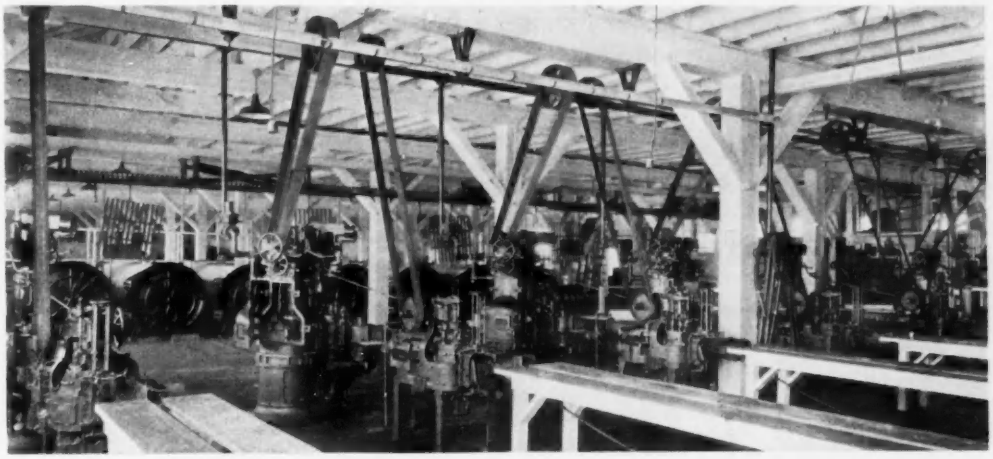

FIGURE 11.—Rotary filling machines that automatically salt and fill cans with salmon. Empty tins are delivered from can making machines on the upper floor and the filled cans pass along the slot in the table where men remove any excess fish where necessary. (Courtesy of Juleen, Everett, Washington.)

minimum of storage space is required, and the cans can be made by one or two girls as fast as needed for canning.

The capacity of a cannery is best measured by the number of "lines" of machinery installed. The actual pack of salmon depends on the catch available. The NRA Code of Fair Competition for the Canned Salmon Industry approved in May, 1934, limits employees to an 8-hour day and 40-day week, but permits overtime to prevent spoilage of fish. In practice a cannery must operate each day during the season long enough to care for all the catch brought in that day even if this requires operation for 16 hours instead of 8 hours. Quality canned salmon cannot be produced from fish that have deteriorated.

After the supply of fish has been canned each day the floor, tables and all machines are thoroughly scrubbed. There are no offensive odors or flies in a cannery since the fish are packed before they deteriorate and everything is kept scrupulously clean. It takes about two hours to clean up a plant each day. At the close of the season, after an extra vigorous cleaning, all machinery is opened and greased to prevent damage during the winter. An association of salmon packers maintains an inspection service to insure sanitation and quality standards in the product.

In canning salmon about one-fourth of the weight of fish handled is thrown away. The aggregate waste is enormous since this material could be utilized in by-products. Some oil and fertilizer was made from salmon waste at Astoria in 1888. Since then several by-product plants have begun operations. Four plants are operating on Puget Sound mostly on offal from salmon canneries. A large plant at Ketchikan, Alaska, built in 1914 ceased operations with increased costs that accompanied the "boom" years and has not been reopened. Some canneries discard the tail section of salmon because of the excessive amount of bone that otherwise would be canned, although this might better be used for a cheaper grade of canned salmon, since it is perfectly good food. The heads, viscera, fins, and tail are dumped into the water underneath the cannery or into scows that are emptied into deeper waters. This method of disposal pollutes rather than benefits adjacent waters. The offal makes excellent fertilizer, also fish meal that, mixed with other ingredients, becomes a favored food for cows, hogs, and poultry in part because of its vitamin content. Salmon oil made from the fish heads might find profitable markets. A good grade of caviar can be made from salmon eggs instead of sturgeon eggs. A difficulty in fertilizer manufacture is that present methods require a plant too expensive for most single canneries. A simple process where installations would

FIGURE 12.—New England Fish Company, cannery and cold storage plant, at Ketchikan, Alaska. This plant stores several million pounds of frozen salmon and halibut. (Courtesy of Thwaites.)

FIGURE 13.—Cannery at Hawk Inlet at low tide. Steamship loading canned salmon to Seattle. About 100 men are employed in this cannery. At high tide the beach is covered within a few feet to the buildings at the right.

cost only $2,000 or $3,000 would be widely adopted and would utilize the offal now discarded. Such a plant must operate without odor, otherwise visitors to salmon canneries would thereafter have a prejudice against canned salmon thinking that the odor showed a lack of sanitation.

Half the annual pack of salmon comes from Alaska. Only a few towns in Alaska like Ketchikan, Petersburg, and Juneau have living accommodations for workmen and can supply an appreciable amount of labor. Even in the towns mentioned a majority of the employees come from the States to work in canneries during the season and do not become permanent residents of the territory. Most Alaska salmon canneries are isolated little communities populated only in the summer. A canning center somewhat resembles a mining or sawmill hamlet in that all these examples consist of isolated communities in the midst of a wilderness where all residents depend wholly on a single plant for employment.

Cannery locations require: plenty of fish, a safe ship landing, and an adequate supply of fresh, pure water. Most salmon are caught during the migrations of schools of the fish toward streams in which they spawn. Favored sites for canneries would be near the head of an inlet into which a river flows or on some little bay convenient to points by which salmon migrate so that they may be caught by traps in large quantities. There should be sufficient depth of water for supply ships close enough to shore so that a long, expensive wharf is not required. No highways reach Alaska from the States. All imports and exports travel by water. The isolated salmon canneries lack even trails to the few settlements. All communication must be by sea. Mountains rise steeply from the ocean and a cannery seems like a speck in the landscape. No automobile, road, or horse exists in the community.

The cannery builds on piles, usually creosoted, over the beach to deep water into which fish refuse may be dumped. A wharf provides room for a single ship. Besides the cannery itself there is a storehouse for canned salmon, perhaps a machine shop, and at a safe distance, in case of fire, are storage tanks or a shed for storing gasoline and oil required by the fishing boats. There is a company store handling groceries, clothing, and odds and ends sold usually at Seattle prices or perhaps at a 10 per cent increase. Most companies do not operate the store for profit but rather to supply the needs of employees at a reasonable cost and so help keep the men contented. The store contains the post office. Communication by radio has

become a necessity to control the movements of supply ships and to care properly for large salmon runs. There is a dormitory and boarding house for single men, although sometimes groups club together and feed themselves. Two or three modern houses provide homes for the manager and his family and a few other executives. Sometimes flowers and vegetables are planted. Cows and chickens are absent. A dozen or score of neat wooden shacks, placed in a row along a board walk facing the sea are the homes of married Orientals and Indians whose families came with them. The fishermen that supply the cannery often occupy these small company houses. Others may be used by workmen who prefer to "batch." Indian fishermen may build ramshackle unpainted huts themselves on the shore beyond the company property. Probably three out of four salmon canneries and associated houses and other buildings are painted red like a barn or freight car, the others use white or other colors.

Much water is used by the canneries and it is essential that each have an abundance of pure, fresh water. In the humid climate of the mountainous coast of Alaska water can usually be easily found. A nearby stream or spring supplies a reservoir and a wood stave pipe a few hundred yards long delivers the water into a tank or directly for use at desired pressure. Shower baths are often provided for employees.

A modern cannery with machinery, wharf, homes for workmen, boats, nets, etc., represents an investment of around $200,000. On this interest must be earned and expenses paid during a season that may last only 45 days.

FIGURE 14.—Cannery at Shakan, Alaska. Cannery Buildings are built on piles over the water at the left. The huts of the fishermen string along the shore at the right. There are no roads from this settlement. All communication is by sea. Located at the foot of the steeply raised mountains. (Courtesy of Thwaites.)

Figure 15 is the cannery layout at Skowl Arm, Alaska. The photo, Figure 14, shows the building hugging the shore at the foot of densely forested mountains that descend abruptly into the sea. It is a wild region. The writer, while visiting the plant on two separate days, saw bears along the shore across a cove a few hundred feet from the cannery. In the summer of 1934 ten whites and 40 Filipinos worked in the plant. Several independent fishermen also lived there. 58,500 cases, mostly

of pink salmon were canned in 1934 at this plant. If fish had been available the output would have been larger.

Figure 13 shows a larger salmon canning community, that of P. E. Harris & Co. at Hawk Inlet, Alaska. This plant employed 100 Japanese or other Orientals. About 40 white persons including some women and children spent the summer of 1934 there. 150 Indians, including families of fishermen, came for the season and helped catch the salmon. In the summer this community had nearly 300 persons in residence but in the winter only one white man and two Japanese remained as watchmen and caretakers. The advanced men in the crew arrived about April 1 and began preparations for the canning season. Some trap men came in late April, others not until June. The canning season in 1934 lasted 45 days from July 12 to August 25. This plant during the day of the author's visit canned 3,600 cases of salmon. One day they canned 35,000 humpback salmon and found only 3 sockeyes in the run. Thirteen traps furnished most of the fish to this cannery. Native fishermen operated 3 boats and other men 7 boats that supplied the rest of the fish.

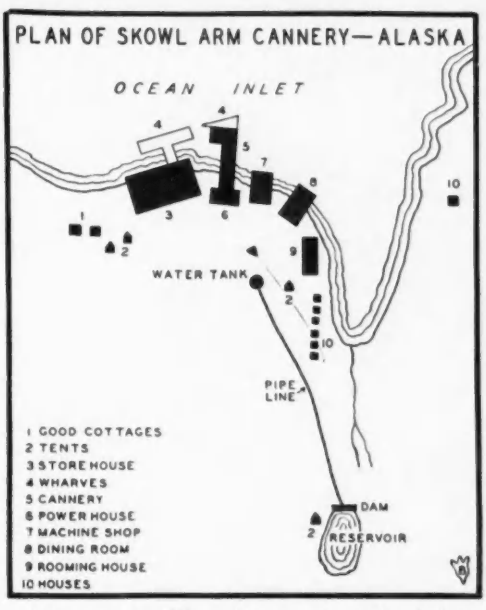

FIGURE 15.—Plan of cannery at Skowl Arm, Alaska.

FIGURE 16.—The Donna Lane in Port Armstrong Bay at Alaska, used as a floating factory for mild curing of King salmon.

Alaska Indians have always gained their living from the sea and continue today to be of some importance even to the canning industry. For example Metlakatla, Alaska, is a model Indian village founded by Rev. James Duncan. The Indian fishermen here catch all the salmon canned at a plant originally built by the Indians. Terrakee Inlet cannery has the usual dormitories and ten huts for employees, with a big house for the manager, but also employs many Indians, at least 20 shacks having been built by them in a scraggling line down the shore east of the plant. The present policy of the Government is to encourage the Indian to become an independent fisherman. Numerous trap locations have been cancelled by the Government in order to provide more fishing grounds for the Indians who use boats in securing their catch.

SALMON FREEZING AND CURING

While the majority of the salmon catch is canned large quantities of fish are sold fresh, salted, smoked, or mild cured. Freshly caught salmon are sold in the markets of Seattle, Portland, and other centers convenient to the fishing

CANNED SALMON PACK

Year	Puget Sound	Northern Washington Coast	Willapa Harbor	Columbia River	Coastal Streams of Oregon
	Cases *	Cases *	Cases *	Cases *	Cases *
1880	5,100	.....	.....	530,000	7,772
1881	8,500	.....	.....	550,000	12,320
1882	7,900	.....	.....	541,300	19,186
1883	1,500	.....	.....	629,400	16,156
1884	5,500	.....	.....	620,000	12,276
1885	12,000	.....	.....	553,800	9,310
1886	17,000	.....	.....	448,500	49,147
1887	22,000	.....	.....	356,000	73,996
1888	21,975	37,000	22,500	372,477	92,863
1889	11,674	.....	.....	309,885	98,800
1890	8,000	.....	.....	435,774	47,009
1891	20,529	500	8,000	398,953	24,500
1892	26,426	16,500	14,500	487,338	83,600
1893	89,774	22,000	16,195	415,876	52,778
1894	95,400	21,400	15,100	490,100	54,815
1895	179,968	11,449	22,600	634,696	77,878
1896	195,664	21,274	24,941	481,697	87,360
1897	494,026	13,300	29,600	552,721	60,158
1898	400,200	12,100	21,420	487,944	75,679
1899	919,611	24,240	21,314	332,774	82,041
1900	469,450	30,800	26,300	358,772	12,237
1901	1,380,590	41,500	34,000	390,183	58,618
1902	581,659	31,500	39,492	317,143	44,236
1903	478,488	.....	5,890	339,577	54,861
1904	291,488	27,559	26,400	395,104	98,874
1905	1,018,641	22,050	14,950	397,273	89,055
1906	430,602	22,000	14,440	394,898	197,332
1907	698,080	14,000	13,382	324,171	79,712
1908	448,765	14,000	20,457	253,341	52,478
1909	1,632,949	19,787	12,024	274,087	58,169
1910	567,883	51,130	14,508	391,415	103,617
1911	1,557,029	61,671	25,850	543,331	153,828
1912	416,125	54,507	24,887	285,666	77,765
1913	2,583,463	54,922	8,422	266,479	42,441
1914	792,860	54,109	15,792	455,500	116,335
1915	1,269,206	72,727	12,842	558,534	80,499
1916	707,278	55,692	17,506	547,805	81,843
1917	1,921,554	41,196	8,139	555,218	84,099
1918	624,198	57,015	8,387	591,381	92,457
1919	1,295,626	56,882	6,560	580,028	76,284
1920	166,520	1,527	60	481,545	35,061
1921	653,490	9,562	5,216	323,241	15,754
1922	248,729	50,608	2,749	392,174	26,287
1923	758,138	47,334	8,609	480,925	47,411
1924	317,649	30,782	15,755	500,872	61,403
1925	911,670	36,659	16,617	540,452	55,686
1926	310,425	14,501	11,219	479,723	31,001
1927	892,244	19,359	17,531	519,809	48,619
1928	325,376	20,496	16,535	446,646	19,047
1929	1,131,844	24,583	16,936	422,117	15,060
1930	572,606	28,907	6,684	429,505	12,233
1931	948,881	20,263	.....	353,699	12,834
1932	310,911	37,959	.....	296,191	8,524
1933	771,776	14,202	1,556	336,711	7,650
1934	500,093	20,005	2,485	362,721	6,100

* Reduced to common basis of forty-eight one-pound cans to the case.
† Estimated.
‡ Does not include packs of Soviet organizations, on which no information was available.

BY WATERS, 1880–1934

Northern California Coast	Sacramento-Monterey District	Alaska	British Columbia	Siberia	Japan	Total
Cases *	Cases *	Cases *	Cases *	Cases *	Cases *	Cases *
13,750	62,000	6,539	61,849	.....	.....	687,010
.....	181,200	8,977	169,576	.....	.....	930,573
.....	200,000	21,745	240,461	.....	.....	1,030,592
.....	123,000	48,337	163,438	.....	.....	981,831
.....	81,450	64,886	123,706	.....	.....	907,918
.....	90,000	82,415	108,517	.....	.....	857,042
.....	39,300	142,065	152,964	.....	.....	848,976
.....	36,500	206,677	204,083	.....	.....	899,256
6,747	68,075	412,115	184,000	.....	.....	1,217,792
.....	57,300	719,169	417,211	.....	.....	1,614,066
.....	25,065	682,591	411,257	.....	.....	1,609,696
.....	19,353	801,400	314,511	.....	.....	1,578,746
.....	2,281	474,717	248,721	.....	.....	1,354,083
3,100	23,336	643,654	610,202	.....	.....	1,876,915
3,200	28,463	686,440	492,232	.....	.....	1,887,150
3,850	25,185	626,530	587,692	.....	.....	2,169,848
.....	13,387	966,707	617,782	.....	.....	2,408,812
.....	38,543	909,078	1,027,183	.....	.....	3,124,609
.....	29,731	965,097	492,551	.....	.....	2,484,722
1,600	32,580	1,078,146	765,519	.....	.....	3,257,825
.....	39,304	1,548,139	606,540	.....	.....	3,091,542
.....	17,500	2,016,804	1,247,212	.....	.....	5,186,407
2,500	14,043	2,436,824	627,161	.....	.....	4,194,558
.....	8,200	2,246,210	873,847	.....	.....	3,607,073
3,400	14,407	1,953,756	465,894	.....	.....	3,276,882
.....	2,780	1,894,516	1,167,822	.....	.....	4,607,087
.....	.....	2,219,044	629,460	.....	.....	3,817,776
.....	.....	2,169,873	547,459	.....	.....	3,846,677
.....	.....	2,606,973	566,303	.....	.....	3,962,317
5,633	.....	2,395,477	993,060	.....	.....	5,391,186
14,016	.....	2,413,054	760,830	10,000	.....	4,326,453
7,604	4,142	2,820,066	948,965	25,000	.....	6,147,486
33,200	.....	4,060,129	996,576	63,100	.....	6,011,955
6,376	950	3,746,493	1,353,901	133,400	46,000	8,242,847
14,000	17,315	4,067,832	1,111,039	136,500	65,450	6,849,732
15,933	7,129	4,489,341	1,138,381	289,009	70,000	7,998,592
11,389	19,445	4,919,589	995,065	425,800	47,800	7,829,212
14,330	11,443	5,922,330	1,577,485	511,001	56,152	10,692,047
21,100	4,036	6,677,569	1,616,157	381,337	26,490	10,100,127
19,597	3,169	4,592,201	1,383,156	748,511	68,500	8,840,514
20,628	427	4,429,463	1,187,616	595,771	25,000	6,910,092
10,376	.....	2,604,973	603,548	705,493	7,500	4,939,153
9,700	.....	4,501,428	1,290,326	718,184	.....	7,240,185
6,000	.....	5,063,340	1,341,677	703,669	.....	8,457,103
12,936	.....	5,305,923	1,745,313	799,120	10,000†	8,799,753
22,339	.....	4,450,898	1,697,298	586,663	90,000†	8,408,282
11,537	.....	6,652,882	2,064,922	946,188	26,500	10,548,898
15,585	.....	3,566,072	1,357,697	817,835	132,000†	7,386,751
4,237	.....	6,070,110	2,035,629	1,482,469	219,369†	10,639,914
2,774	.....	5,370,242	1,399,352	1,002,912	635,425	10,021,245
5,171	.....	4,988,987	2,221,819	1,752,112	378,404	10,396,428
12,280	.....	5,432,535	686,524	1,130,009	458,270	9,055,295
780	.....	5,260,488	1,074,342	1,246,760‡	247,251	8,483,206
2,419	.....	5,226,698	1,265,072	671,043‡	772,924	9,069,781
.....	.....	7,470,586	1,582,796	1,388,921‡	892,570	12,226,277

NORTH AMERICAN CANNED

Species	1934	1933	1932
Red or Sockeye	3,354,933	2,579,891	2,482,800
Pink	4,261,262	3,259,341	2,341,817
Chum	1,362,905	1,021,547	1,310,038
Coho, Silverside, Medium Red	596,951	402,107	445,456
King, Chinook or Spring	352,552	343,442	394,698
Steelhead Trout	16,183	19,486	14,386
Total	9,944,786	7,625,814	6,989,195

FIGURE 17.—Barrels or tierce of salt salmon on the deck of the Donna Lane at Port Armstrong, Alaska.

grounds. Around 26,000,000 pounds of fresh salmon worth over $1,000,000 land at Seattle alone each year. More of the fish, however, are marketed frozen. In this condition they keep indefinitely in cold storage, stand long shipments under refrigeration and can be sold during the closed season. The king and coho are the species usually chosen for freezing. Steelhead trout and chum salmon are also frozen but the sockeye is rarely used because its flesh is too oily. The freezing process is usually carried on in connection with canning or other methods of preserving and permits buying fish when they are cheap and selling in the off season at better prices. The finest and freshest fish are chosen for freezing. After freezing, the fish are dipped into water

PACIFIC FROZEN FISH PRODUCTION 1934

District	Halibut Pounds	Salmon Pounds	Steelhead Pounds	Misc. Pounds	Totals
Alaska	6,133,142	5,534,916	27,272	323,178	12,018,508
British Columbia	8,955,815	10,182,469	40,672	1,100,628	20,280,582
Puget Sound	9,592,971	8,276,309	54,479*	2,687,807	20,611,566
Columbia River and Coast	199,362	489,183	959,916	204,385	1,852,846
California	128,083	698,723	.....	1,769,922	2,596,728
Total	25,010,373	25,181,600	1,082,339	6,085,918	57,360,230

* All Steelheads frozen on Puget Sound were Columbia River fish shipped to Seattle for freezing.

SALMON PACK BY SPECIES, 1926–1934

1931	1930	1929	1928	1927	1926
2,084,385	1,710,018	2,100,787	2,214,498	1,738,054	2,550,771
3,890,755	4,266,301	3,775,764	3,583,433	2,241,304	4,101,422
671,574	1,085,351	1,541,213	2,165,652	1,217,338	1,762,134
388,140	758,451	564,826	602,203	642,522	607,778
418,483	427,282	375,497	354,798	538,574	485,788
13,679	18,509	24,821	17,492	33,377	36,233
7,467,016	8,265,912	8,382,908	8,938,076	6,411,169	9,544,126

and refrozen to glaze them. The resulting coat of ice protects the fish which are piled up like cord wood in rooms kept at a temperature of about 15° F. Before cooking, the fish should be thawed slowly. Frozen salmon contain the same vitamins as fresh salmon and form just as wholesome food. Large cold storage plants for salmon, halibut, and other fish have been built. Ten or more cold storage warehouses exist at Seattle, which has the greatest storage capacity, closely followed by Ketchikan, Alaska, and Prince Rupert and Vancouver, B. C. Other important plants exist at Sitka, Petersburg, and Juneau with a dozen smaller warehouses for cold storage at various places on the Columbia River and on the coast from San Francisco to Kodiak Island, Alaska. From 20,000,000 to 25,000,000 pounds of salmon are frozen for market annually in some three dozen cold storage plants.

The earliest method to preserve salmon consisted of pickling the fish in brine in the proportions of 15 pounds of salt per 100 pounds of cleaned fish. Because canneries generally pay more for fish than the salters can afford the output of pickled salmon is less than formerly. Alaska produces practically all of the salt salmon. The highest output of salt salmon in Alaska was reached in 1918 with a production of 56,983 barrels. By 1929 this had declined to 2,871 barrels packed by 20 concerns. Only 50 barrels of salt salmon were produced from outside of Alaska.

Mild curing continues to demand 15,000,000 to 20,000,000 pounds of king and silver salmon annually. The fish, generally caught by trolling, require careful handling. After removing head and entrails the fish are thoroughly washed and the skin is scored to assist the curing process. Next the fish are split in halves and the backbone is removed, after which the sides are packed in a large wooden cask called a tierce and pickle is added in the proportion of 85 to 100 pounds of salt to 800 pounds of fish. A tierce holds about 825

CANNED SALMON EXPORTS FROM U. S. IN 1934 IN POUNDS

To Countries Taking Over 100,000 Lbs.

United Kingdom	41,455,276
Netherlands	1,202,650
Belgium	316,380
Irish Free State	234,194
Canada	341,371
Panama	217,346
British India	113,808
Netherland East Indies	157,474
Philippine Islands	1,379,686
Australia	1,494,770
New Zealand	165,717
Union South Africa	301,640
Total	48,608,948

PLANTS OPERATED IN 1934

	Canneries	*Cold Storage Salmon and Halibut*	*Mild Curing*
Western Alaska	12	..	..
Central Alaska	39	..	25
Southeast Alaska	34	25	..
Puget Sound	21	13	11
Columbia River	11	11	7
Washington and Oregon Coast	8	2	3
California	..	15	12
Total United States	125	66	58
British Columbia	42	12	6
Japan	52	..	..
Kamchatka	38	..	1
Total	257	78	65

pounds of salmon. The output averages 15,000 to 20,000 tierces per year on the Pacific Coast of America of which about 80 per cent consists of king salmon and the balance cohoes or silver. Sides of salmon 11 pounds or more in weight are called "large", 9–11 pounds, "medium" and below 9 pounds per side "small". Mild curing of salmon is carried on at more than 60 plants all along the coast from California to Alaska. Some of the plants are floating hulks that can move to the best available fishing. About 1,000 tierces per year come from two plants in Kamchatka. The chief buyers of mild cured salmon are the makers of smoked salmon. The greater part of the product sells in Europe, Germany being the largest consumer. Smoked salmon is a great delicacy there and is classed with caviar for flavor by many epicures.

In smoking salmon, the fish, generally mild cured, are kept in the smoke from a fire of non-resinous wood for 8–10 hours. In case a hard smoking is required sides may be left for one or two days until dry. Smothering the fire with sawdust produces the desired color on smoked salmon.

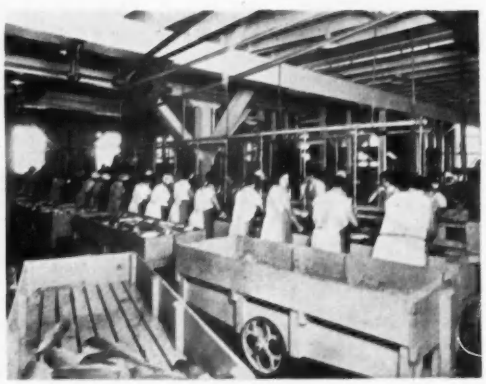

FIGURE 18.—Women workers cleaning the salmon at the priming tables after the fish have been passed through the Iron Chink. This operation is to remove all remaining bits of fins, tails, or blood in the backbone; and after this operation the salmon are entirely ready for packing in the can. (Courtesy of Pacific Fisherman.)

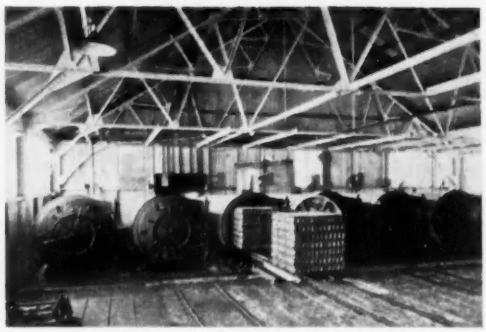

FIGURE 19.—A row of fixed retorts and the method in which the cans are piled in coolers and on four-wheel retort cars. (Courtesy of Pacific Fisherman.)

On the Pacific Coast practically all kippered salmon is made from white-meated king salmon which because of the lack of red color is not favored for canning. Sections of the fish weighing about a pound are pickled for several hours in strong brine, then dipped into vegetable coloring to give the red color demanded by the customer. The pieces of fish are then dried and smoked for 16 to 18 hours over a medium fire.

MARKETS

The highest value placed on canned salmon produced in the United States, including Alaska, totaled $56,219,000 in 1926. The years 1928 and 1929 had values almost as high although 1926 had the largest pack. Declining prices since have caused a smaller total value although the total pack has been maintained very well.

The bulk of the canned salmon comes to Seattle and from there is distributed to consuming markets in the United States and abroad. The canned product is stored at Seattle in large warehouses while awaiting a sale. Most canneries market through jobbing or wholesale agents for both domestic and export trade. One large chain store has its own canneries in Alaska. Also several large distributing concerns handling food products have their own canneries.

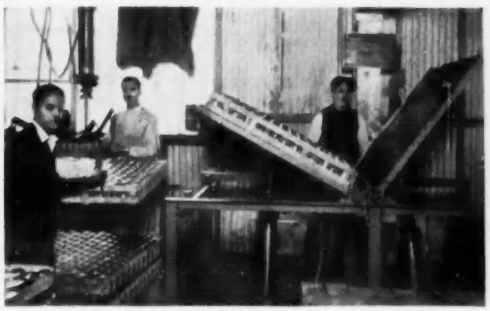

FIGURE 20.—The patented system of dumping the cans from the coolers, just prior to the casing operation. (Courtesy of Pacific Fisherman.)

Most canneries use several brands for different qualities of the various varieties of salmon. Many wholesale grocery companies, who do not own a cannery, have the fish packed with labels of their own so that the good will developed by a special brand belongs to them and not the packer, who indeed may be a different firm each year.

In the export trade Seattle generally ships more salmon to foreign countries than all other ports of the United States combined. San Francisco is second and New York a distant third in exports. The three ports totaled 38,000,000 pounds of exports of canned salmon in 1929 of which Seattle handled 23,000,000 and San Francisco 13,600,000. In that year canned salmon was shipped to 93 different countries starting alphabetically with Aden and ending with West Indies.

While the great majority of the canned salmon pack finds a market in the United States nevertheless the product has been exported to nearly every country on earth and is probably the most common of all American canned food products to be purchased abroad. The best customer for canned salmon is Great Britain which consumes around half a million cases per year. France stands generally in second place and Australia third among consuming nations. New Zealand, Chile, Italy, and the Philippines are other leading customers for canned salmon. Europe buys the most and Africa the least canned salmon among the continents. Germany buys the most mild cured salmon.

While import quotas and high tariffs have interfered with exports of salmon products to some countries the United States is favored in that the only competitors of our country in the salmon industry are Canada, Siberia, and Japan. So far the Asiatic output has not seriously disturbed the American markets.

AGRICULTURAL REGIONS OF ASIA

PART VII—THE JAPANESE EMPIRE*

(*Concluded*)

Robert Burnett Hall

THE Japanese Empire is and, with the exception of its limited northlands, has been from remotest times an agricultural land. Even in Japan Proper, which we think of more and more as an industrial and commercial country, slightly over half of the population is directly engaged in agriculture. In the other parts of the Empire there is little other occupation than farming. In Chosen and Taiwan at least 80% of the population is so employed.

The total productive area of the Empire is comparable in size to the state of Tennessee and yet supports a population of some 95 million people or nearly four-fifths of the population of the entire United States. Pressure of population upon the arable land is a critical problem throughout most parts of the Empire and has led to the intensive utilization of small farm areas. In Japan Proper, there is about one-half acre per unit of farm population. This figure, however, includes the northern Japan region where the average is about four times as large. In the older parts of Japan, such as the Kinai District, and in Ryukyu from one-quarter to one-third acre now suffice. In Chosen, where less intensive methods and a generally lower living standard prevail, about three-quarters of an acre per person is employed. (See Table on pp. 144 and 145.)

JAPAN PROPER—END OF 1931

35.0% of farmers worked less than 5 tan
34.0% of farmers worked 5 to 10 tan
22.0% of farmers worked 1 to 2 cho.

In general, the size of farms increase from south to north in all of the four regions of the Empire. Farms are smallest where two crops of rice can be secured from the same land as on the Kochi Plain of Shikoku and on the southern plain of Taiwan. Fields tend to be smaller where fall-sown dry crops can be planted on paddy fields, and upland farm areas are larger than paddies.

The agriculture of the Empire may be described, in general, as a grain agriculture, in which rice predominates, supplemented by vegetable and other gardening. Except for pigs in Taiwan and Chosen and a recent but not greatly important development of meat and dairy production in Hokkaido, the animal industries are generally lacking except to produce draught animals.

RICE

Rice is the first crop of the Empire, and except for sugar cane in Taiwan and Ryukyu and a few specialized garden crops in Old Japan, such as flowers, fruits, and high grade tobacco, it has first claim to all of the land which will produce it. Paddy rice occupies 47.3% of all the arable land of the Empire and accounts for 60% or more of the value of all agricultural production. Rice is the first crop in point of acreage in all districts of Old Japan. It occupies the highest percentage of the arable land in Kinai, Setouchi and Nankai, and the lowest percentage in Tosan. It is the first crop of Hokkaido, where it is of

*The writer is especially obligated to Professor Akira Watanabe of the Japanese Imperial Military Academy for advice in the field and for supplying numerous materials which have been used freely in this and the first installment. He is also obligated to Miss Fumi Oi for numerous translations and compilations.

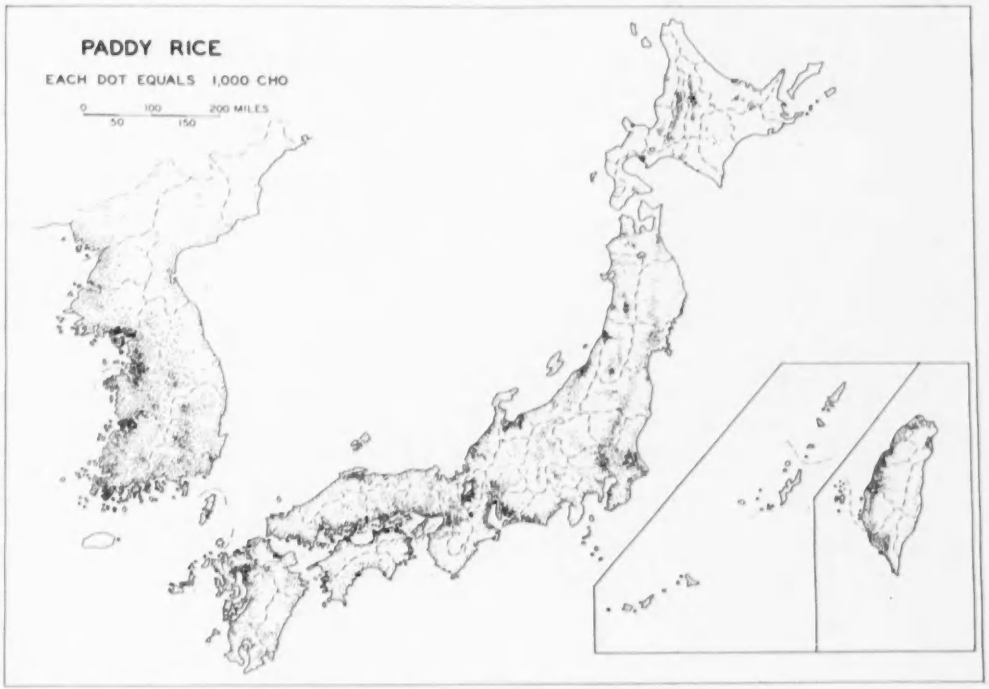

FIGURE 26.—Rice is the major crop of Japan.

largest importance in the south and west and of the least importance in the north and east.[1] In Ryukyu and Taiwan, rice is now exceeded in acreage by the sweet potato. Sugar cane occupies large areas which were once paddy fields, and the sweet potato has increased rapidly in recent years as a sustenance crop. In Chosen, rice is the first crop in acreage but occupies only 37.2% of the arable land as against 53.9% in Japan Proper and 49.2% in Taiwan.

Rice shows the most uniform distribution of any crop grown in the Empire. The area it occupies, with few exceptions, outlines the alluvial plains of the Empire from the southernmost tip of Taiwan to beyond the isopleth of 100 days growing season in Northern Hokkaido and Chosen. In Taiwan, there is a considerable acreage of paddy on the imposing, contour terraces of the mountain slopes. In Setouchi, and in parts of Kinai and Nankai, less spectacular artificial terraces are also found. In several places, where irrigation and surface conditions are favorable, rice paddies are found on natural terraces of young diluvium. In a few areas they occupy terraces of old diluvium and at least on Sado Island they are found on Tertiary terraces. In Hokkaido, especially on the Tokachi Plain, peaty soils have successfully been converted into rice fields.

Virtually all of the paddy rice of Japan Proper is irrigated. Canal, tank, and well irrigation is employed. In many instances the water available for irrigation determines the extent of rice cultivation. The relatively complete development of irrigation possibilities in the older parts of Japan account to a large extent for the important position of rice there. The immature develop-

[1] Davis, D. H., "Agricultural Occupation of Hokkaido," ECONOMIC GEOGRAPHY, Vol. 10, No. 4, October, 1934, p. 356.

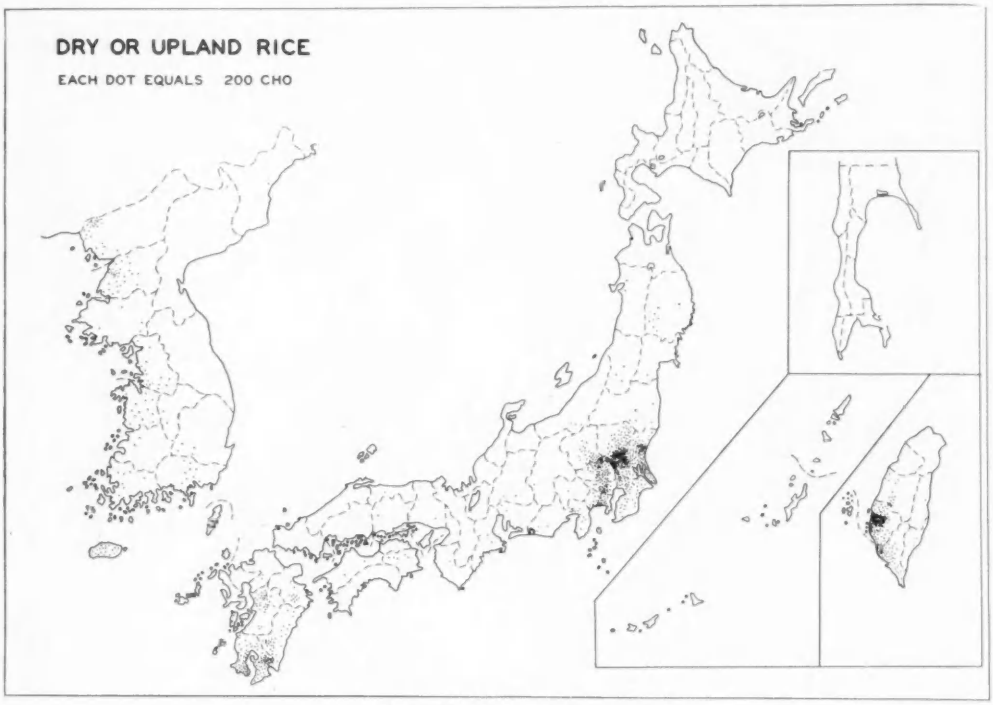

FIGURE 27.—Upland rice is only locally important.

ment in Northern Honshu in part explains its lesser importance. In Chosen, probably 50% of the wet rice area must depend upon rainfall alone. Much the same condition prevails in parts of Taiwan. Inadequate irrigation facilities and less intense fertilization explain in part the relatively low yields of these two regions. In both, however, there have been marked improvements in irrigation in recent years.

The acreage of rice in Japan Proper increased steadily during the past half century, but the rate of increase has been decreasing rapidly in recent years. It is to be seriously doubted that the present acreage will be maintained, as the cost of production in many areas is too great to allow a profit in years of normal prices.[2] The average yield per acre has also been greatly increased, but there has been no improvement during the last decade. As a result of the extension of acreage and increased yield the rice crop of Japan Proper has been about doubled since 1880. The yields per acre in Hokkaido, because of less favorable climatic conditions and less mature development, are about 70% of the average for Japan Proper.

In Chosen, both area and yields are still increasing and probably will for some time to come. The average yield in Chosen is about 25 bushels to the acre as compared to nearly 40 in Japan Proper. In Taiwan, lower yields are offset by the fact that much of the rice land yields two crops. In 1931, the first crop occupied 282,861,000 ko [3] and the second crop occupied 370,520,000

[2] The average yield of rice per tan in 1932 for Japan Proper was 2.2555 koku. The average price for medium grade rice was 21.15 yen per koku or an average value of 47.69 yen per tan of medium grade rice. The average cost of production per tan covering all factors is well over 50 yen. Unquestionably, much of the paddy land of Japan Proper is marginal.

[3] One "ko" is approximately 1 cho.

ko, or a total effective rice-producing area of 653,380,000 ko per annum as against a real area of 411,073,000 ko of paddy land. The growth of the sugar cane industry at the expense of rice and the rapid extension of the sweet potato have caused the percentage of paddy land to total arable land in Taiwan to decrease from 75% in 1925 to about 50% in 1931.

The people of Japan Proper have the highest living standards in the Far East. They prefer rice to all other grains and can afford to eat it in larger quantities than most of their neighbors. The per capita consumption for 1932 was 1.014 koku, which gave a consumption total of over 66 million koku. Of this amount less than 10 million koku was carried over from the preceding year, 55,215,000 koku were produced in Japan Proper and the balance of 11½ million koku was imported. Of this amount Chosen furnished over three-fifths, Taiwan supplied nearly a quarter, and the balance was imported from foreign countries.

Dry or upland rice is of little importance, occupying only 206,500 cho. The major centers of production in order of importance are the diluvial terraces of Kwanto, the dry central portion of the Taiwan Plain, the ash plateau of Southern Kyushu and scattered areas in western Chosen. There is virtually no dry rice on the margins of the Sea of Japan nor in Hokkaido or northernmost Chosen.

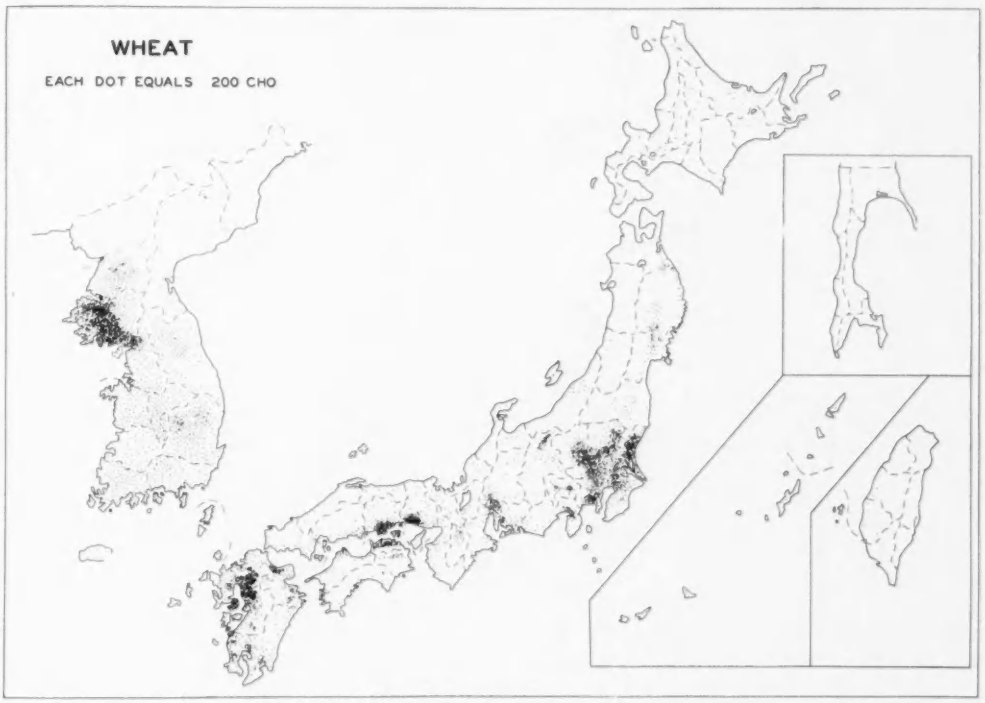

FIGURE 28.—Wheat is a dry land, or dry season, crop.

"MUGI" (BARLEY, RYE, WHEAT AND OATS)

The combined acreages of the several grains—barley, wheat, rye and oats—which go under the general term of "mugi," is approximately 56% of that of paddy rice. In the Northern Japan region they comprise about 95% as much

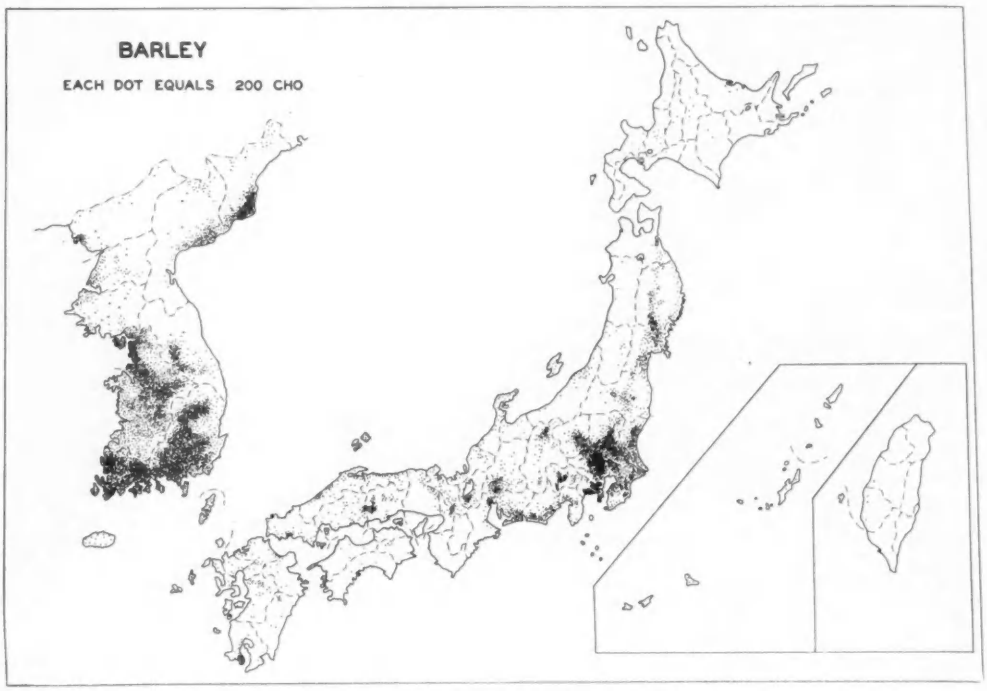

FIGURE 29.—Barley acreage is declining in Japan.

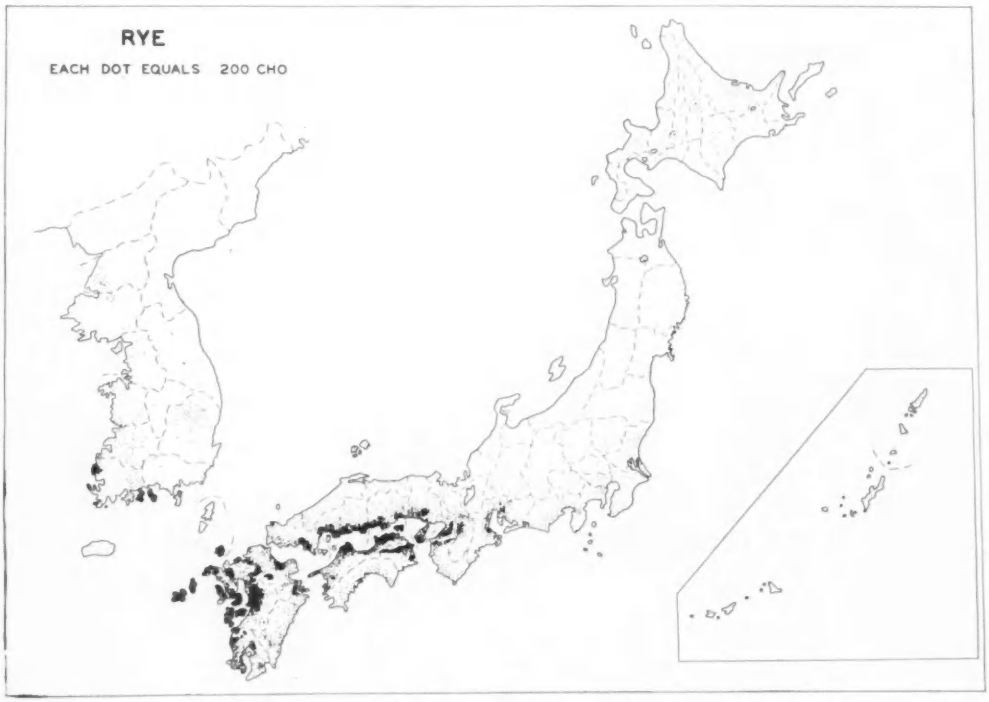

FIGURE 30.—Rye is a dry season crop on the paddy lands.

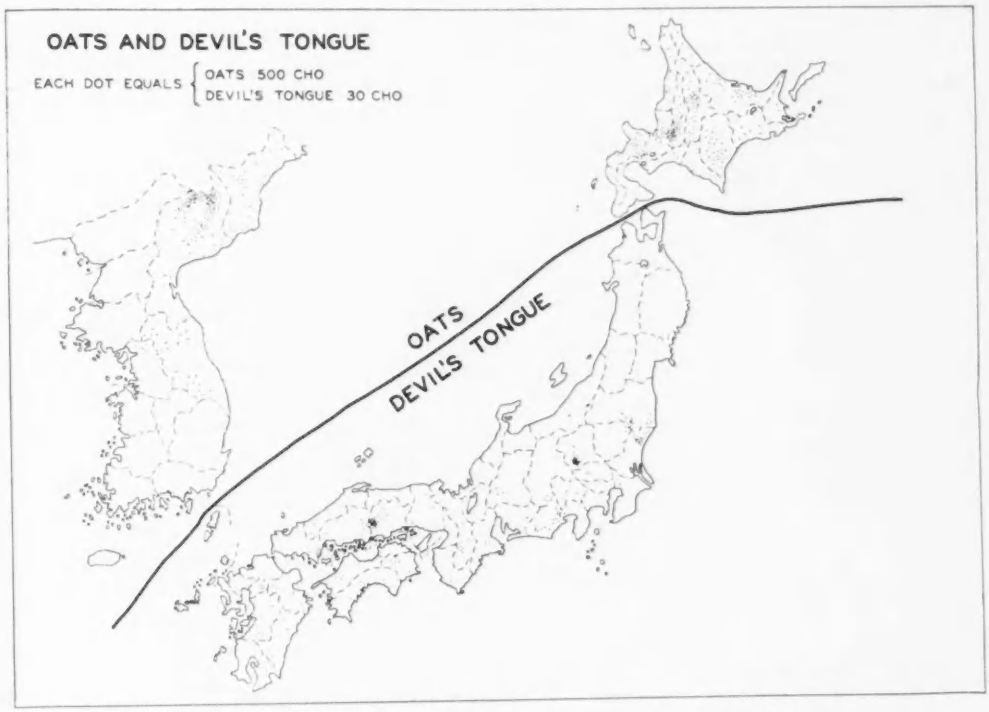

FIGURE 31.—Oats and devil's tongue have little importance.

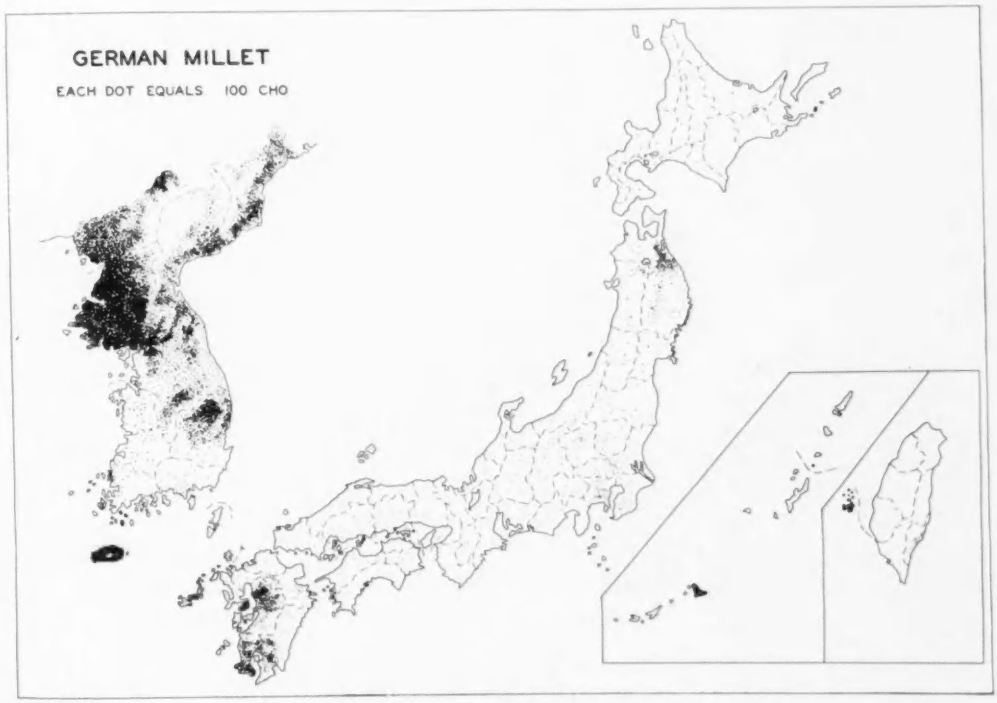

FIGURE 32.—German millet grows best in Chosen.

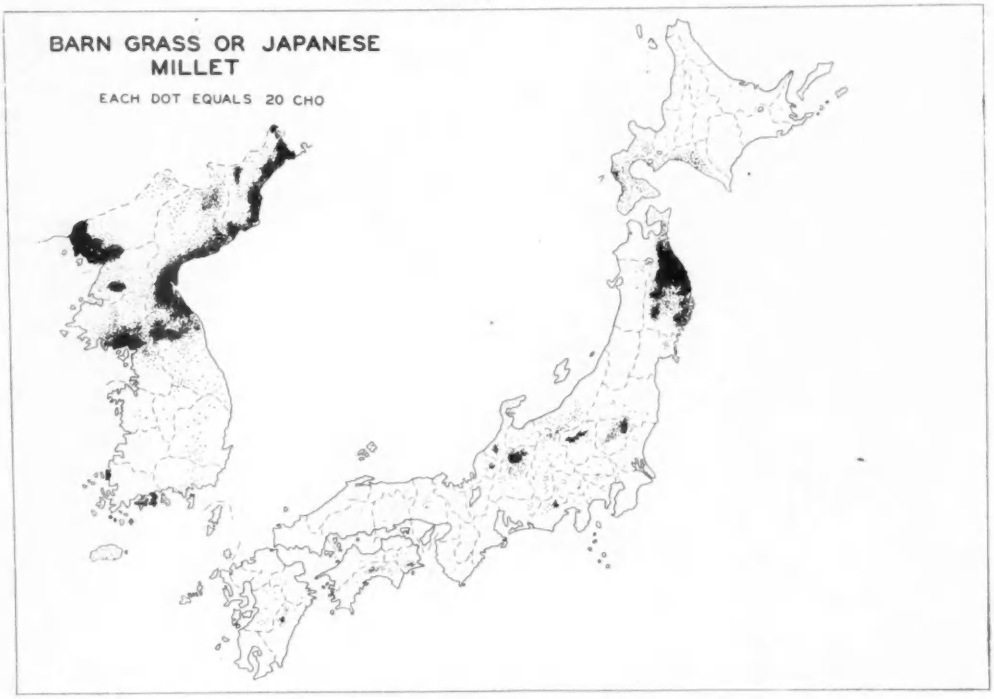

FIGURE 33.—Japanese millet grows locally important.

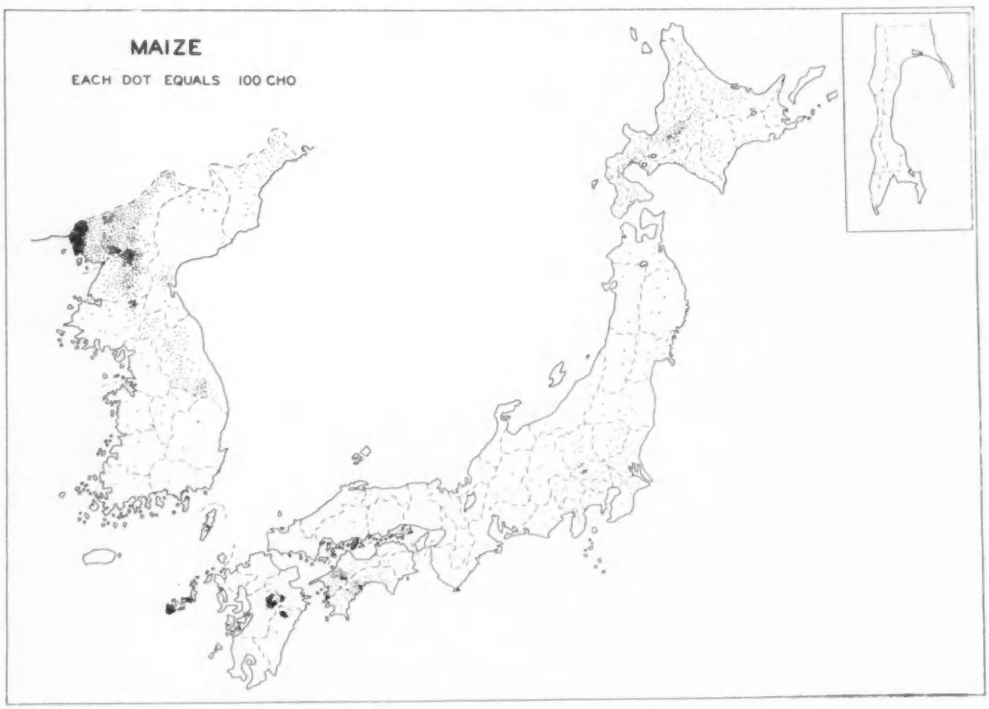

FIGURE 34.—Maize plays small part in Japanese economy.

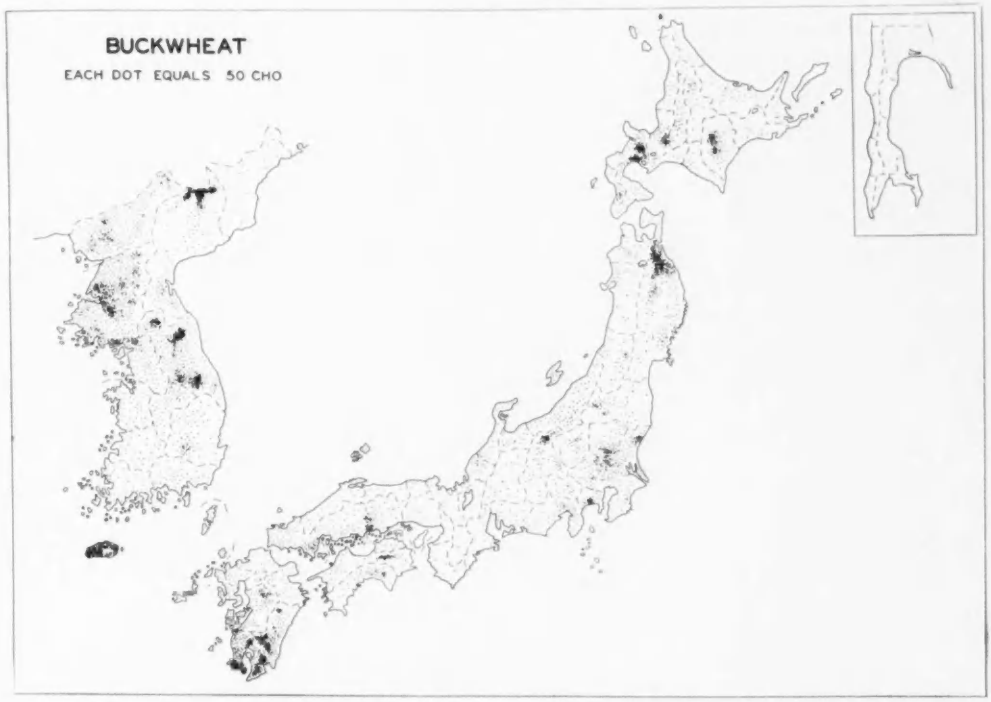

FIGURE 35.—Buckwheat generally indicates unfavorable agricultural conditions.

area as does rice, in Old Japan 42% as much, in Chosen 87%, and in Ryukyu and Taiwan only about 1%.

These grains are produced in part as upland crops and in part as dry season crops on paddy land. The following table shows this division in Japan Proper for 1932:

Barley	on paddy	106,987 cho
	on upland	273,085 cho
Rye	on paddy	296,422 cho
	on upland	183,267 cho
Wheat	on paddy	233,788 cho
	on upland	274,929 cho

Less than 1,000 cho of oats were planted on paddy fields.

In the Northern Japan region, in Northern Chosen, and to a limited extent in Ou these dry grains are spring sown. In these areas, there is practically no double cropping. In Old Japan and in Middle and Southern Chosen these crops are fall sown either on paddy or upland. On the upland farms interculture is intensively practised and vegetables and other crops are grown with them.

The major concentrations of barley production are found in the Southern Chosen and Kwanto districts. In the former, barley is largely a second crop on rice land while in Kwanto it is an important crop of the unirrigated terrace lands and more gradual slopes. The yield per tan of barley in Japan Proper in 1930 was 2.06 koku as compared with the 1904–08 average of 1.63. The area, however, has decreased by nearly 25% during the same period and in consequence the total production has declined considerably. The decline in acreage is in part due to the expansion of mulberry, paddy, and vegetable fields and in part due to a smaller per capita consumption. Rice has to a large extent taken the place of dry grains in the national diet. In Chosen, opposite trends are noticeable and a steady increase is taking place.

The decline in wheat acreage in Japan Proper is much smaller than that of barley or rye. More bread is being eaten especially by the urban population, and the government has given strong protection to its growers. The yield per tan has increased by about 25% and production is maintaining itself. In Chosen, there has been an appreciable increase in recent years. The major concentrations of wheat acreage in the Empire are Kwanto, west central Chosen, and northern Kyushu behind Nagasaki. Secondary concentrations are found in the Setouchi district and on the Nagoya Plain. Wheat in Kwanto and west central Chosen is largely a dry land crop while in Setouchi, Southern Chosen and Northern Kyushu it is principally a dry season crop on paddy land.

Rye is particularly the dry season crop on the paddy lands of Setouchi and western Kyushu. It is likewise grown, but in much smaller quantities, in Southern Chosen and in the Kinai and Tokai districts. In Hokkaido it is a spring sown dry land crop as it is in Northern Chosen. The same declining trends can be noted in Japan Proper as is true of barley.

Oats are confined almost exclusively to the Northern Japan Region and to Northern Chosen where they are spring sown dry land crops. In Hokkaido the production has increased with the increasing animal industries. It has nearly doubled in the last sixteen years. In Karafuto, a similar rate of increase is taking place. In Northern Chosen, oats form an important part of the diet of migratory, "fire-field" people of the mountain lands.

THE MILLETS

The millets, like barley and rye, formerly made up a more important part of the peasant's diet than they do today.

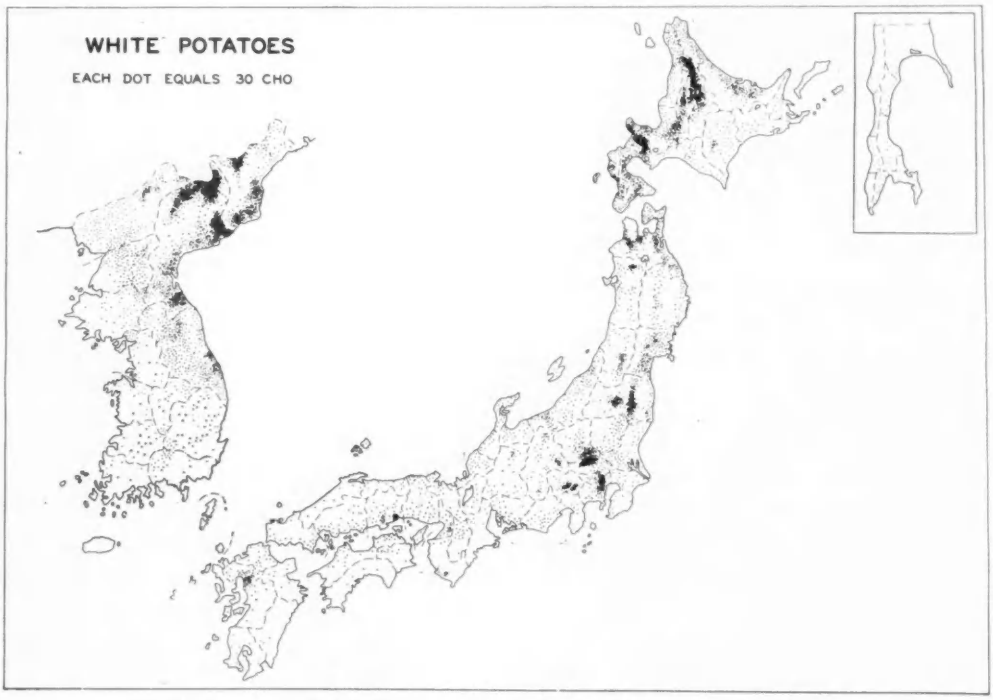

FIGURE 36.—White potatoes grow chiefly in the northern section.

All of the several kinds of millets seem to be definitely on the decline. They are dry land crops and have their major concentrations in areas of dry agriculture. In Northern Chosen the millets form an important part of the rural diet. In northeastern Ou they are largely fed to livestock. In Southern Kyushu and on Saishu Island, off southwest Chosen, thick coverings of volcanic detritus limit the area of paddy land and compel the growing of drought resistant crops. In both areas they are used both as human and stock food.

MAIZE OR INDIAN CORN

Corn has not as yet found an important place in the agriculture of the Empire. In Japan Proper its production is on the decline. The major concentrations are found in northeastern Chosen, in Hokkaido, on the slopes of the Aso caldera in Kyushu and in western Shikoku. In Japan Proper corn is largely a stock food, though the hot roasting ears of the night stands in Tokyo find a ready market. In Northern Chosen, corn is an important human food in some districts and there is a large American managed cornstarch factory near Heijo.

BUCKWHEAT

Buckwheat is grown widely over Japan Proper and Chosen and its occurrence is often an indication of unfavorable agricultural conditions. It is especially concentrated in Northern Chosen, in Hokkaido, northwestern Ou, Southern Kyushu and Saishu Island. In Hokkaido, Karafuto, and Northern Chosen some increase is taking place. In Old Japan buckwheat production is showing a slight decline. A noodle called "soba" is made from buckwheat and is greatly liked by Japanese people.

THE SWEET POTATO AND THE WHITE POTATO

The sweet potato is largely confined to the Ryuku-Taiwan Region and Old

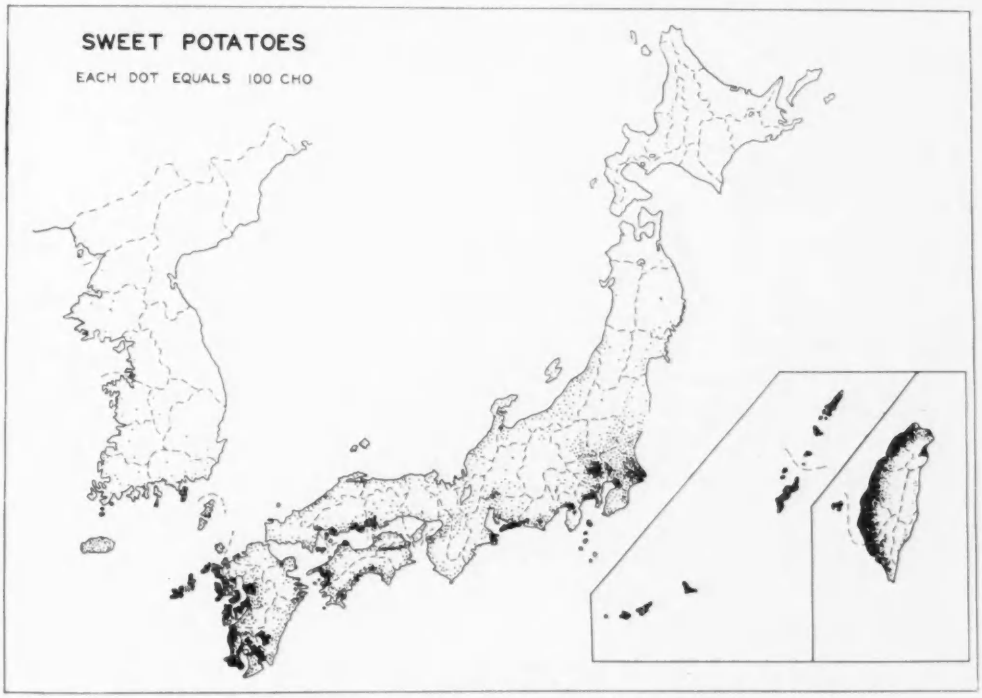

FIGURE 37.—Sweet potatoes form a major element of the diet in Southern Japan.

Japan south of Ou. In Ryuku, Taiwan and Southern Kyushu it forms a major element of the diet. In Kwanto it is grown chiefly for the adjacent urban markets. It is a dry land crop and is well adapted to loose and friable soils. It is an important crop in areas of volcanic detritus such as Southern Kyushu and Saishu Island. In Japan Proper, the acreage is declining, but in Kyushu and Taiwan large increases have taken place as cane fields displace paddy and as rice is exported to Japan Proper.

The white potato like corn has not as yet found an important place in the agricultural economy of the Empire. Its major concentrations, as is to be expected, are found in the cooler North Japan Region and in Northern Chosen. A secondary concentration is found near the great urban markets of Kwanto. Both in Hokkaido and in Old Japan the acreage of white potatoes is steadily declining.

THE SOY BEAN AND "AZUKI" OR RED BEANS

The soy bean is the source of many human foods as well as furnishing stock-food, fertilizer, and industrial oil. Chosen is the most important part of the Empire in this production. Here production is widespread and is increasing rapidly. The soy bean is an important subsistence crop in Chosen and ranks second only to rice among the exports to Japan Proper. In Hokkaido, production is still increasing but in Old Japan it is on the decline, chiefly because of the competition imports from Manchoukuo.

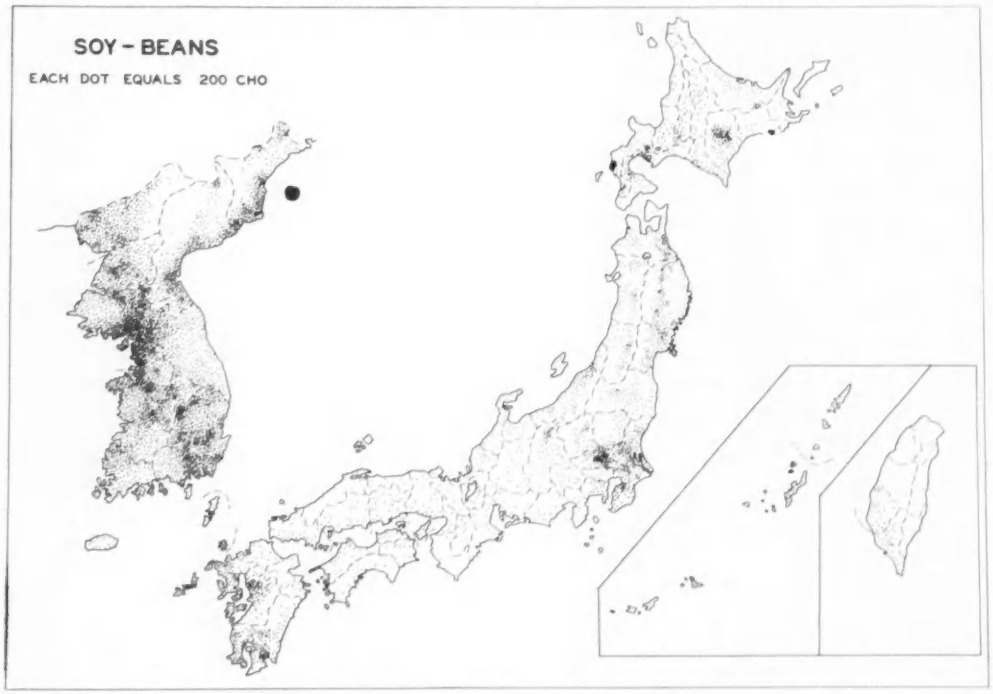

FIGURE 38.—The soy bean supplies many human needs.

Red beans likewise seem to be on the decline in Old Japan, though increasing in Hokkaido and Chosen. The greatest concentration occurs in northwestern Chosen, although the Tokachi and central plains of Hokkaido are large producers.

PEANUTS

Peanuts are confined largely to two areas, Kwanto and Taiwan. The production in Japan Proper which has been declining for some years has again shown a tendency to increase. Peanuts constitute a staple crop throughout Taiwan which accounts for five-sevenths of all the production of the Empire.

which is exported to Europe and the United States. The Shizuoka area produces almost entirely commercial green tea, the major export markets are the United States, Russia and Canada.[4] The Uji area produces the highest grade teas for Japanese consumption. The Koreans, strangely, are not tea drinkers. Some tea is now imported by the wealth-

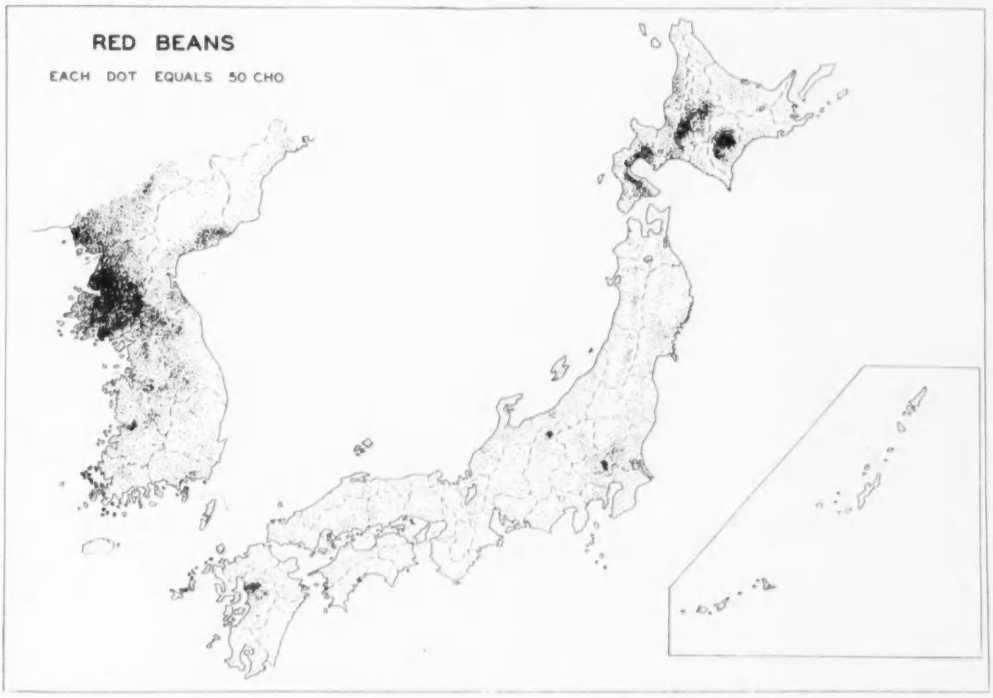

FIGURE 39.—Chosen and Hokkaido grow many red beans for food.

TEA

The production of tea in the Japanese Empire centers largely about three areas —northern Taiwan, Shizuoka Prefecture in the Tokai district and the Uji area in the Kyoto Plain of Kinai. In addition a good deal of tea is grown throughout Japan Proper, south of the Ou district, for local use on many farms. The acreage of northern Taiwan is somewhat larger than that of Japan Proper and is increasing, while that of Japan is gradually declining. It produces chiefly oolong tea, much of

ier classes from Japan Proper, but there is virtually no tea produced in Chosen.

RAPE AND COTTON

The production of rape seed is virtually confined within the Empire to Old

[4] Trewartha, G. T., "A Reconnaissance Geography of Japan," *University of Wisconsin Studies in the Social Sciences and History*, 1934, p. 60. Unfortunately, this excellent geographical reconnaissance had not appeared when the first two installments of this article were written. See also Trewartha, G. T., "A Geographic Study of Shizuoka Prefecture, Japan," *Annals Assoc. Amer. Geog.*, Vol. XVII, No. 3, Sept. 1928, p. 202–209, and also Trewartha, G. T., "The Tea Crop," *Jour. Geog.*, XXVIII, Jan. 1921, p. 19–24.

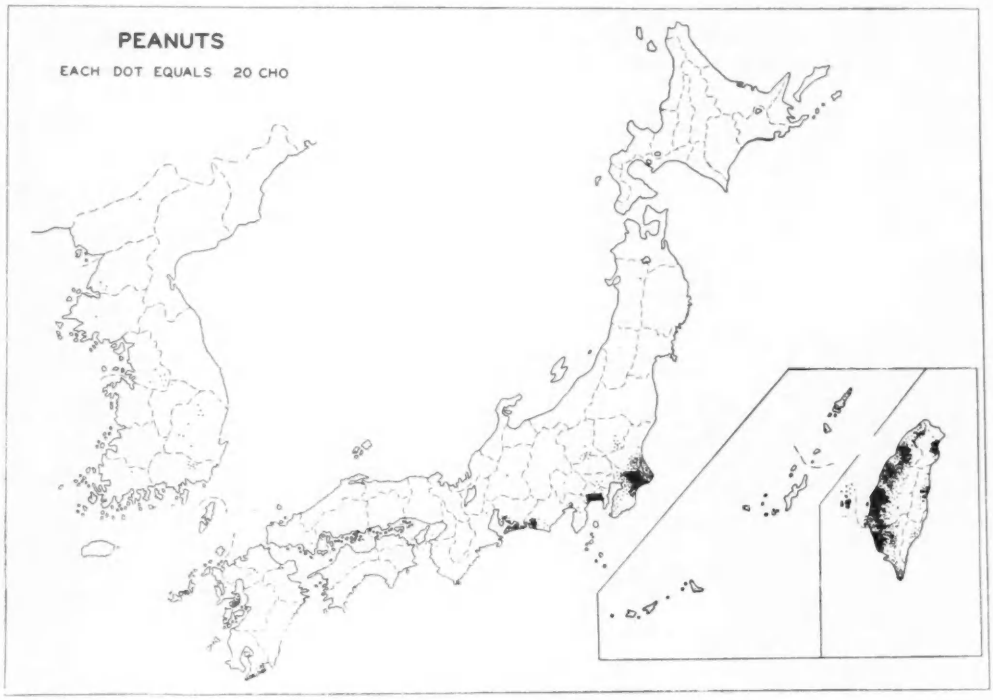

FIGURE 40.—Peanuts constitute a staple crop in Taiwan.

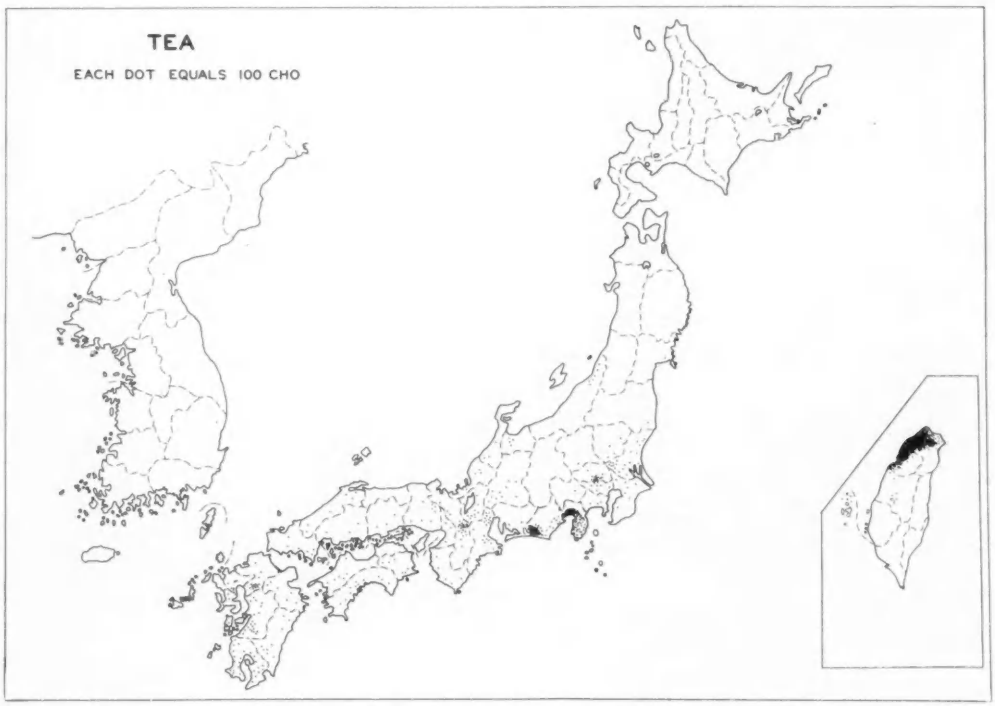

FIGURE 41.—Tea production in Japan centers about three areas.

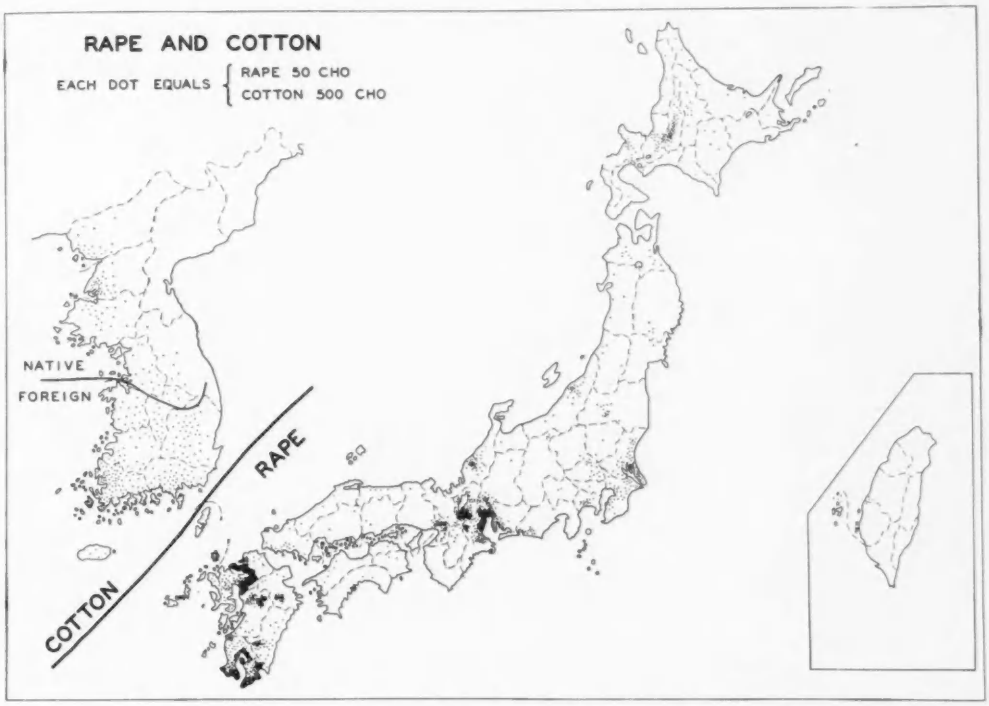

FIGURE 42.—Cotton and rape production have both declined.

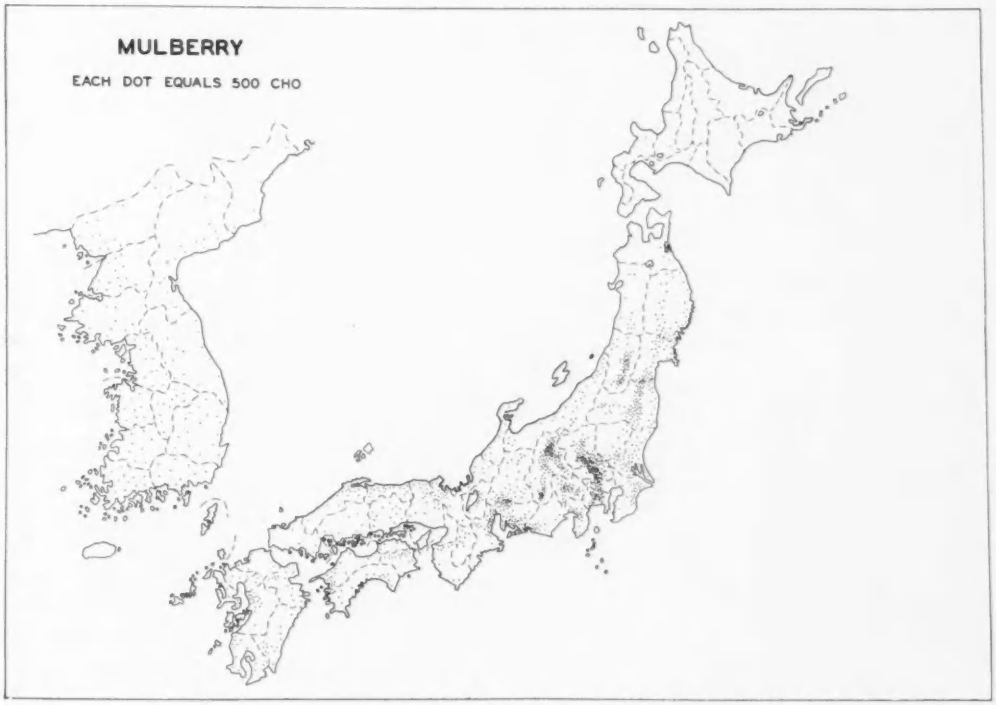

FIGURE 43.—The mulberry indicates the regions of silk production.

THE MAJOR AGRICULTURAL USES OF THE LAND AND KINDS OF LIVESTOCK IN THE JAPANESE

(Data in Thousands of Cho

Division	Total Arable Land	Paddy Rice	Dry Rice	Barley	Rye	Wheat	Oats	Millet	Barnyard Millet	True Millet	Corn	Buckwheat	Sweet Potatoes
I. Old Japan	4,952.1	3,158.9	133.8	395.3	473.8	460.5	.....	105.1	38.3	9.4	35.1	95.3	259.2
(A) Ou District	881.6	491.0	3.9	60.2	.6	26.1	.....	20.0	26.0	.7	2.3	19.6	4.1
(B) Hokuroku District	505.9	376.9	.7	19.3	.7	14.8	.....	3.8	5.0	.8	.4	7.0	12.0
(C) Tosan District	128.6	56.0	.....	10.2	.....	3.4	.....	1.5	1.2	.1	.2	3.0	.3
(D) Kwanto District	961.3	402.0	90.0	178.8	11.8	166.7	.....	11.4	3.4	1.8	6.9	17.0	58.0
(E) South Sea Islands District	3.0	.....	.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.0
(F) Tokai District	502.4	260.5	4.8	75.6	20.9	42.7	.....	3.0	.7	2.2	4.4	5.0	18.4
(G) Kinai District	243.7	239.5	.5	10.4	70.2	11.8	.....	.3	.....	.2	.2	.3	5.1
(H) San-in District	201.4	134.0	.3	16.5	10.6	4.4	.....	1.6	.....	.4	.3	3.0	6.3
(I) Setouchi District	436.2	414.5	.6	25.5	143.0	61.8	.....	4.2	.....	1.9	2.0	9.0	24.4
(J) Nankai District	261.9	339.5	1.0	3.0	49.0	8.6	.....	1.5	1.0	.6	8.7	4.4	25.3
(K) Northern Kyushu District	464.9	310.2	6.5	15.8	119.6	84.7	.....	27.4	.2	.5	3.8	6.0	45.0
(L) Southern Kyushu District	361.0	134.8	25.3	10.0	55.4	35.5	.....	30.4	.8	.2	5.9	21.0	57.3
II. Ryukyu-Taiwan Region	895.3	417.5	40.2	1.8	.3	2.8	.....	5.5	.....	4.5	.....	.....	152.0
(A) Ryukyu District	59.9	6.4	.02	1.0	.3	1.6	.....	2.3	.....	1.3	.....	.....	30.0
(B & C) Taiwan Totals	835.4	411.1	40.0	.8	.....	1.2	.....	3.0	.....	4.2	.....	.....	122.0
(B) Western Taiwan District	.....	314.5	38.6	.7	.....	.....	.....	.....	.....	.....	.....	.....	.....
(C) Eastern Taiwan District	.....	96.6	1.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
III. Northern Japan Region	845.3	178.0	.7	6.2	28.2	13.7	121.2	1.7	3.8	13.0	16.4	23.1	.04
(A) Hokkaido District	829.3	178.0	.7	6.0	27.4	13.5	114.2	1.7	3.8	12.2	16.3	22.0	.04
(B) Karafuto District	16.1	.....	.....	.2	.8	.2	7.0	.01	.....	.1	.1	1.1	.....
IV. Chosen Region	4,384.0	1,643.0	27.8	898.0	99.0	323.0	116.9	883.0	109.4	17.2	93.4	105.0	11.1
(A) Southern Chosen District	.....	748.0	9.0	506.0	42.0	86.0	.....	85.0	.....	.....	1.5	.....	10.0
(B) Middle Chosen District	.....	539.0	.6	261.0	5.0	146.0	17.0	201.0	.....	.....	16.5	.....	.6
(C) Northern Chosen District	.....	348.0	12.4	108.7	7.0	108.0	100.0	222.0	.....	.....	75.0	.....	.5
Honshu Totals	4,001.0	2,301.6	102.8	424.2	198.5	315.1	.1	45.9	35.4	7.9	14.9	63.7	128.1
Shikoku Totals	250.5	141.3	1.3	2.2	107.8	26.6	.....	2.1	1.0	.9	10.4	4.9	28.8
Kyushu Totals	825.9	434.1	33.6	26.0	210.0	120.2	.....	60.9	0.8	.7	9.4	26.8	102.2
Japan Proper Totals	5,992.0	3,185.0	134.0	380.0	475.0	501.0	118.0	134.0	42.1	24.6	46.0	106.0	264.0
Grand Totals	11,020.4	5,213.5	206.5	1,370.3	574.0	825.4	238.1	995.3	151.5	44.1	51.5	118.4	422.3

* These data were drawn from many sources and are variously dated between 1926–1932. The regional data and that for districts were computed by "Mura" where those data were available, and otherwise by "ken." They can be regarded as approximate only.

† Includes only radishes. "Daikon" or white radishes occupied 100,000 cho in Japan Proper in 1931.

‡ Data for 1926, after H. Nasu, "Modern Industrial Series," Vol. I, except for Chosen which was computed from "Agriculture in Chosen," Chosen Govt.-Gen., 1929.

Japan and Hokkaido, where it is grown as a dry season crop on paddy fields. The seed furnishes a money crop for the farmer and the burnt stalks give fertilizer to the soil. Northwestern Kyushu and Kinai account for much of the production. Both are near large industrial markets. Rape seed production, however, is declining.

Cotton was grown widely in Old Japan in feudal days, but the competition of foreign cotton has caused it to disappear. In Chosen, cotton has been grown for many centuries. The native variety is a short stapled fibre of poor quality and is now largely confined to the middle and northern districts of Chosen. In 1906 the government introduced American Upland cotton into Southern Chosen and has since encouraged its production. Foreign cotton now occupies the bulk of the cotton acreage. This production now accounts for one of the major exports to Japan.

MULBERRY

The character range of mulberry extends northward into the valleys of the Ou district and southward for the entire extent of Old Japan. It is virtually absent in Ryukyu and only experimental farms grow it in Taiwan (200 cho in 1931). In Chosen, production occurs

EMPIRE BY REGIONS, DISTRICTS, MAJOR POLITICAL ENTITIES, AND LARGER ISLANDS *
and Head of Livestock)

Potatoes	Soy Beans	Peanuts	Vegetables	Tea	Rape	Sugar Cane	Cotton	Mulberry	Cattle	Milch Cows	Horses	% ‡ of Paddy Double-Cropped	Cho ‡ of Farm Land per Farm Family	% ‡ of Arable Area to Total Area
50.5	299.2	9.4	395.9	44.0	74.4	.....	.....	444.1	1,389.9	47.0	1,262.1	....	....	....
18.0	83.3	.1	46.4	.3	1.8	.....	.....	83.5	51.1	2.7	468.9	1.9	1.45	12.7
7.0	30.0	.1	30.9	1.7	2.7	.....	.....	24.2	34.2	2.8	68.9	20.2	1.13	19.5
.9	9.3	....	5.4	....	....	.....	.....	39.0	5.3	1.1	30.9	44.2	0.90	12.0
9.0	77.2	6.7	85.0	6.0	5.9	.....	.....	86.2	82.4	13.9	236.3	23.0	1.09	29.1
.....	.....	....	....	....	....	.....	.....	....	.2	2.5	.....	....	....	....
3.1	10.6	1.1	37.0	17.0	7.2	.....	.....	92.5	51.3	7.9	80.4	47.2	0.83	21.4
1.5	4.9	....	30.0	4.0	17.0	.....	.....	15.2	95.2	4.9	8.5	58.6	0.74	15.7
1.4	3.4	....	18.0	.7	.5	.....	.....	21.3	148.0	.7	13.3	51.1	....	....
4.4	17.5	....	51.0	2.3	1.5	.....	.....	21.3	412.4	5.2	45.3	65.4	....	....
.6	6.0	.6	22.0	3.3	1.2	.....	.....	22.8	113.7	1.5	34.0	62.4	....	....
4.0	38.0	1.0	47.2	3.5	21.1	.....	.....	21.7	258.2	2.9	177.6	64.4	1.05	21.6
.6	33.0	....	23.0	5.2	15.5	.....	.....	16.4	137.9	.9	198.0	72.4		
.....	16.5	25.1	3.0	46.2	.3	.....	.....	0.2	492.4	.8	36.8	....	....	....
.....	4.5	.03	3.0	.02	....	.....	.....	....	101.5	.3	36.6	29.3	0.75	26.6
.....	12.0	25.0	....	46.0	.3	100.0	.....	.2	390.9	.5	.2	....	....	....
.....	.....	....	....	....	.3	.....	.....	....	.....	....	.....	....	....	....
.....	.....	....	....	....	.01	.....	.....	....	.....	....	.....	....	....	....
45.2	75.7	....	.....	....	5.4	.....	.....	.4	42.9	12.5	296.5	....	....	....
42.2	75.2	....	....	....	5.4	.....	.....	.4	39.8	12.3	289.5	....	4.59	8.8
3.0	.05	....	2.6	....	....	.....	.....	....	3.1	.2	7.0	....	....	....
73.6	809.0	.6	66.0†	....	....	.....	192.0	67.0	1,611.6	.8	55.5	....	1.57	....
.....	231.0	.4	13.0†	....	....	.....	35.0	25.0	.....	....	26.0	....	1.10	....
.....	351.0	.2	22.0†	....	....	.....	20.0	28.1	.....	....	9.0	....	1.78	....
.....	419.0	.1	23.0†	....	....	.....	115.0	24.9	.....	....	20.0	....	2.42	....
46.2	246.6	8.7	299.4	33.0	35.5	.....	.....	478.0	822.8	51.9	892.8	....	....	....
1.2	7.8	....	25.2	2.3	.4	.....	.....	20.8	143.0	1.2	38.3	....	....	....
4.4	70.9	1.3	70.0	8.7	36.7	.....	.....	38.1	425.0	3.8	394.0	....	....	....
95.7	353.0	10.0	530.0	40.0	74.0	26.7	.....	682.0	1,512.3	69.0	1,477.3	37.9	1.09	15.8
169.9	1,200.4	35.1	....	90.2	74.6	126.7	362.0	750.0	3,536.8	70.5	1,533.0	....	....	....

largely on the western side of the peninsula.

This is an expanding industry in Old Japan and Chosen. Both acreage and yield have made rapid increases during the past two decades. The production of silk fits in well with the agricultural economy of both areas and is favored by the distribution of surface features. The work is largely carried on by the women and children and so the labor costs are at a minimum. It gives the farmer a badly needed money crop. The dry terraces and slopes adjacent to the alluvial plains and rice fields offer cheap and satisfactory land for the growing of mulberry. The greatest production per area often occurs on the already productive lowlands, but the importance of this industry to the farmer increases as higher levels are reached. The major production of the Empire centers on Yokohama. The diluvial terrace tops and gradual slopes of the Kwanto district and the high mountain basins of Tosan furnish a large part of the silk of the Empire.

The tobacco industry is a monopoly of the government and the amount and location of production is dictated by it. The outstanding areas of production are the Abakuma Lowland and Northern Kwanto and the ash plateau of Southern Kyushu, especially in Satsuma. In Chosen, much the same distribution as to type is found as is true of cotton. The inferior native grades are grown in all parts of the peninsula while imported grades are confined to the south. In 1931 there were 36,000 cho of tobacco

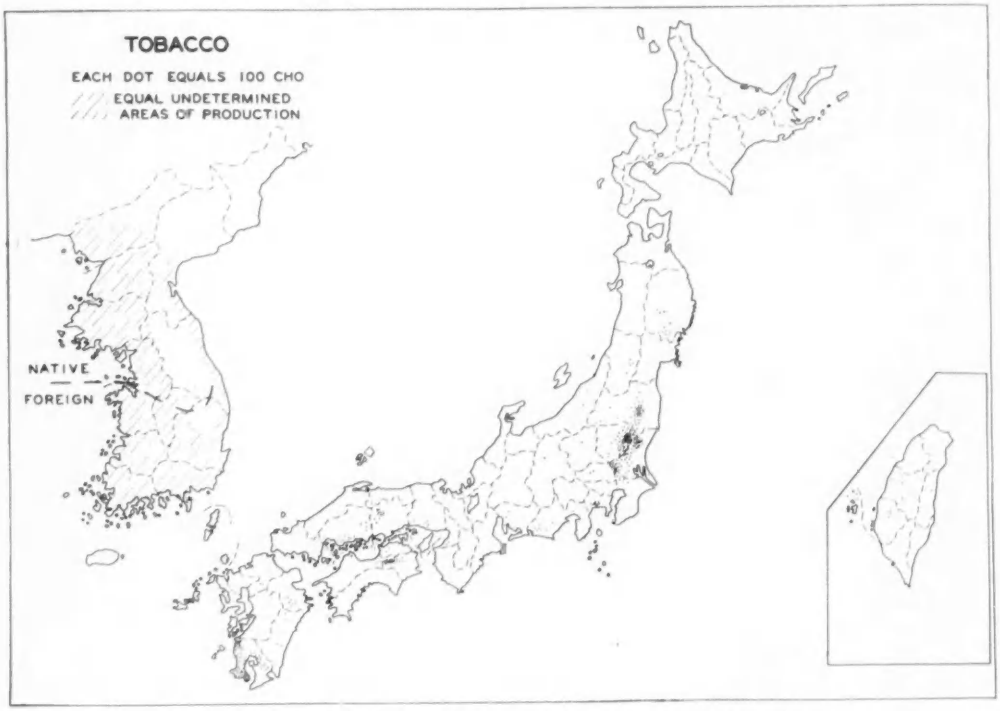

FIGURE 44.—The tobacco industry is a government monopoly.

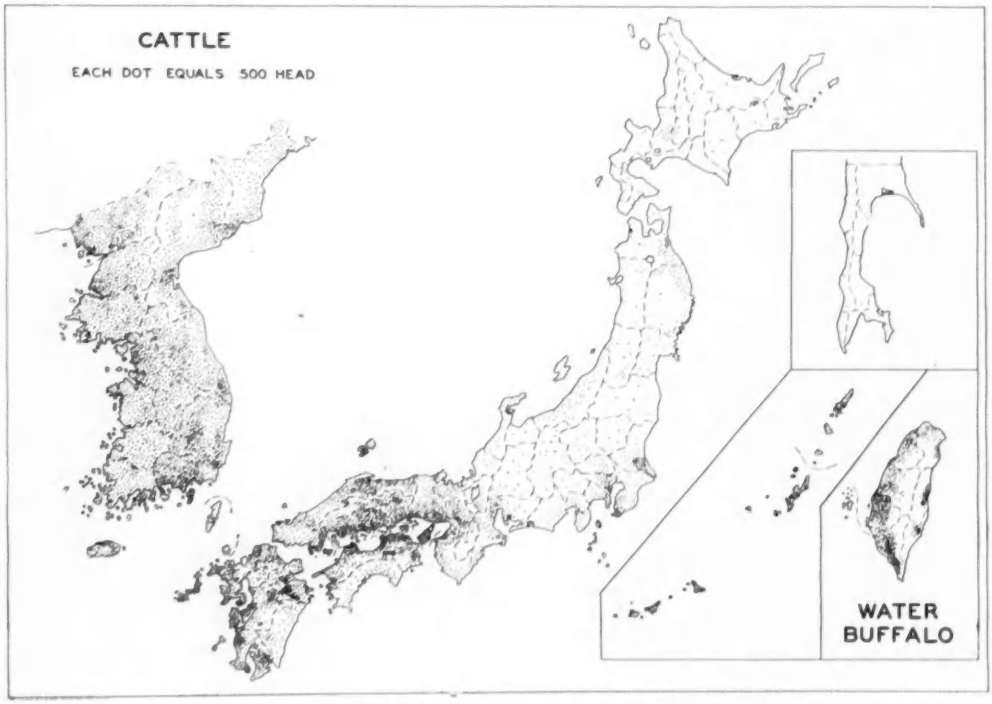

FIGURE 45.—Cattle are regionally important.

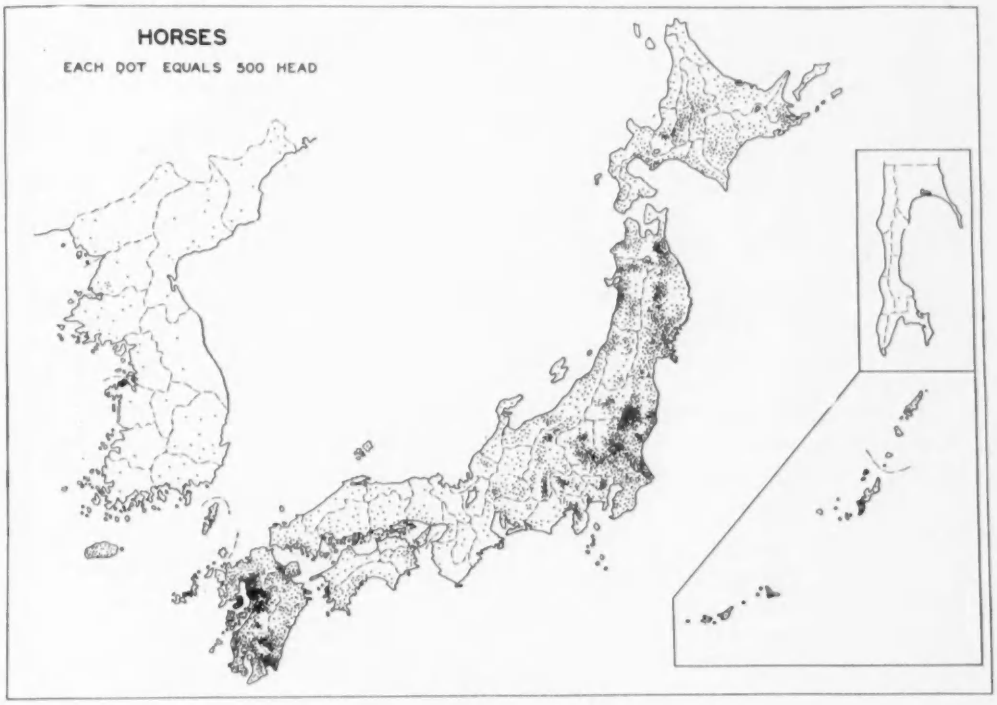

FIGURE 46.—Japan uses relatively few horses.

in Old Japan, 14,229 cho in Chosen, and 900 cho in Taiwan.

LIVESTOCK

Livestock have never been important in Japan Proper, except as beasts of burden and draught animals and the same is true, with the exception of swine, in Taiwan and Chosen. There are several reasons for this: (1) the pressure of population on the land makes it imperative to secure the largest amount of food per unit of arable area, and this can best be done by direct vegetable production; (2) the absence of good pasture grasses or uncultivated lands, except in Hokkaido and Northern Chosen; (3) religious prejudice to meat eating; (4) an abundance of fish; and (5) hot, humid summers which are not altogether favorable to stock rearing.

The following table gives the number of cattle, horses and swine of 1931 for Japan Proper and Taiwan and of 1930 for Chosen:

	Cattle	*Horses*	*Swine*
Japan Proper	1,512,352	1,477,300	947,216
Chosen	1,611,585	55,544	1,386,891
Taiwan	390,854	.....	1,750,464

WATER POWER DEVELOPMENT ON THE DEERFIELD RIVER

A. K. Botts

DEERFIELD RIVER is one of the most completely developed and thoroughly regulated streams in the field of water power production in the United States. From its source in southern Vermont to its outlet into the Connecticut River below Greenfield, Massachusetts, a distance of seventy-two miles, the Deerfield falls 2,000 feet. Eight hydroelectric plants pond and direct the water through turbines which use a total of 1,138 feet of the fall. (See Figure 1.)

The Deerfield was naturally an erratic river, overrunning its banks in the spring but almost dry in late summer and early fall. To insure a more uniform flow two huge reservoirs were provided, one at Somerset, Vermont, and the other at Davis Bridge in the town of Whitingham, Vermont.

The Deerfield, with a drainage area of 675 square miles, is exceeded in size by only one other Connecticut River tributary, the Chicopee River. Deerfield River rises in Stratton and Somerset towns in central Vermont, and flows in a generally southerly direction into Massachusetts as far as the eastern end of Hoosac Tunnel, where it makes a sharp turn to the east and flows in an easterly direction to its junction with the Connecticut. At Shelburne Falls, Massachusetts, it is joined by North River and at Greenfield by Green River. The basin is steep and rocky with but few lakes and practically no natural storage. Much of it is wooded and, except near Greenfield, little land is under cultivation.

As a consequence of sparse population and limited industrial development

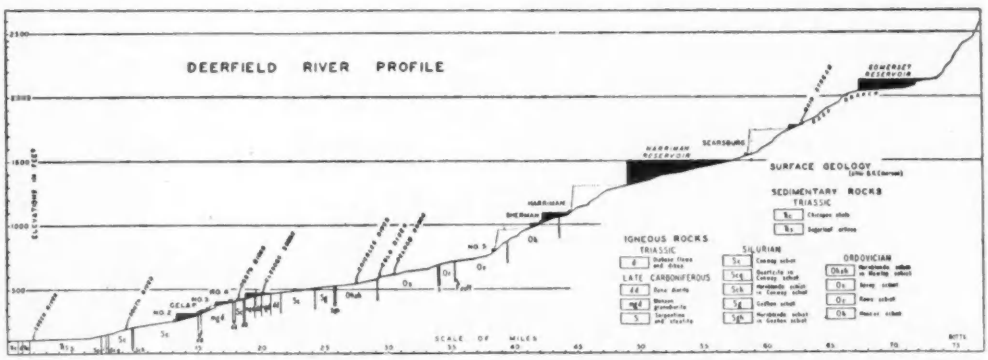

FIGURE 1.—Deerfield River profile. The power developments on the Deerfield are in distinct groups: the upstream group embracing Somerset Reservoir, Searsburg Plant, Harriman Reservoir, Harriman Plant, Sherman Plant, and Number 5, all associated with the gathering of waters in the highlands and the steep descent from the highlands to the foothills region downstream; and the Shelburne Falls group associated with an outcrop of hard Monson grandiorite (mgd) which, adjacent to softer Conway schist (Sc), has created a steep gradient utilized by plants Numbers 2, 3, and 4, and by the Gardners Falls Plant of Greenfield Electric Light and Power Company.

The black areas indicate the extent and elevation of the reservoirs and ponds. The dotted lines represent the effect of conducting the water from the dam to a point directly above the power house where it is to be used. The upstream group of plants utilizes almost every foot of descent from Searsburg pond to the power house of Number 5, in a reservoir, a water conductor, or a power house.

The elevations on this chart are figured from U. S. G. S. data. Elevation 105 feet above mean sea level corresponds approximately with New England Power Company's 0, which is used as data in the text.

within the valley, that valley furnishes a market for less than five per cent of the output of its eight modern hydroelectric plants. All the rest of the Deerfield valley electricity finds a market in the industrial centers of New England, to which it is carried over an extensive system of high voltage transmission lines.

The Deerfield power developments are the property of two large power associations. The oldest plant, the Gardners Falls Plant, was put into operation in 1904 by the Greenfield Electric Light and Power Company. By subsequent mergers and consolidations the establishment became affiliated, first, with the Turners Falls Power and Electric Company, and later, through that concern, with western Massachusetts companies, the chief distributors of power in the central Connecticut valley of Massachusetts.

The other seven stations and the two large reservoirs were constructed by and belong to the New England Power Company, a subsidiary of New England Power Association, New England's largest public utility system, and in 1933 eighth in rank in the United States.

It is as a unit in these huge power producing and merchandising systems that Deerfield valley functions today. The object of this study is to determine some of the geographical aspects of such relationships.

PHYSIOGRAPHIC BACKGROUND

Deerfield valley possesses a considerable degree of geologic unity. Except at its eastern end it consists of old geologic formations (Figure 2). The western and northern parts are made up of ancient gneisses and granites. The central part consists of less resistant phyllites of undetermined age. The lower course of the river, within the towns of Greenfield and Deerfield, lies in a region of soft Triassic sedimentaries.

Geologic structure exerts its influence upon power development in this region mainly as a factor in its physiographic history. The hardness of the bed rock affects the gradient of the stream. Old, resistant rocks of the west and north form a highland. Younger, less resistant phyllites, interrupted by an old hump of carboniferous granite at Shelburne Falls, provide a lower level to which the river formerly descended over

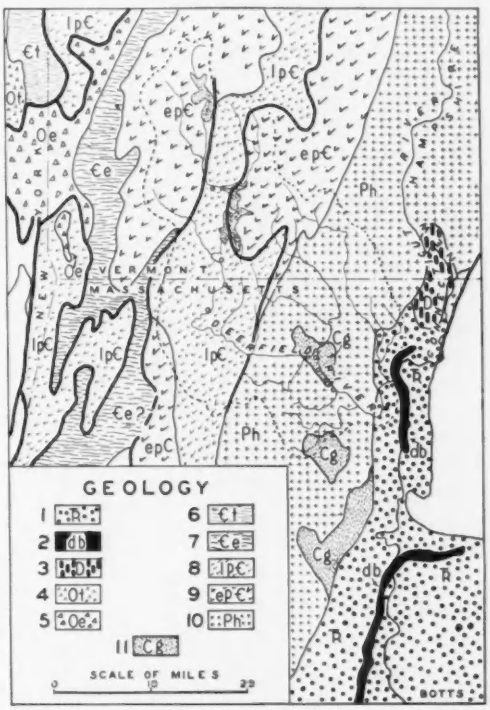

FIGURE 2.—Key: 1. Triassic. 2. Triassic diabase. 3. Devonian. 4. Ordovician (Taconic sequence). 5. Ordovician (Eastern sequence). 6. Cambrian (Taconic sequence). 7. Cambrian (Eastern sequence). 8. Late pre-Cambrian. 9. Early pre-Cambrian. 10. Phyllite of unknown age. 11. Carboniferous granite.

Geology of northwestern Massachusetts and southern Vermont. Deerfield River valley is outlined with a light dashed line. The three principal geological formations in the valley approximate the three physiographic regions outlined in Figure 3. The location of the four lower plants, shown with open circles, is strikingly related to an outcrop of carboniferous granite. (Copied from a tracing supplied by the U. S. G. S. and used with the permission of the director.)

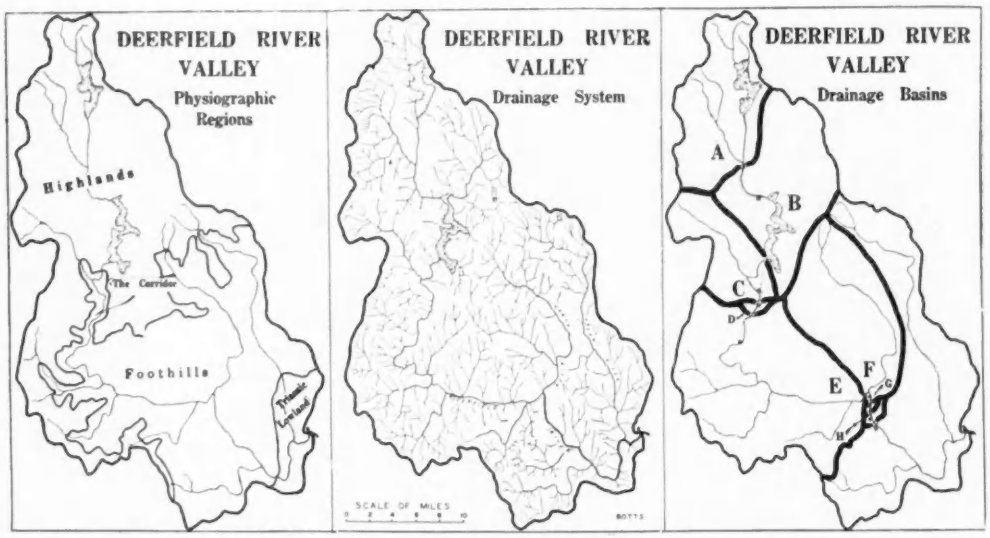

FIGURE 3.—Three phases of the physical environment of Deerfield valley. The first divides the area into three physiographic regions. The long narrow corridor by which the river descends from the highlands to the foothills, contains three of the power houses and about three-fourths of the installed generator capacity of the entire valley. It is significant that both North and Green Rivers descend from the highlands in corridors similar to that occupied by the main stream, but because neither has extensive gathering or storage capacities in the highlands they are of no significance in modern power development.

The right-hand figure indicates the drainage basins contributary to each of the modern plants in the Deerfield system. A, containing Somerset Reservoir, is contributary to Searsburg Plant; A+B to Harriman; A+B+C to Sherman; A+B+C+D to Number 5; A+B+C+D+E to Number 4; A+B+C+D+E+F to Number 3; A+B+C+D+E+F+G to Gardners Falls Plant; and A+B+C+D+E+F+G+H to Number 2.

a torrential course. Very soft Triassic deposits eliminate all but the essential gradient from the lowest seven miles of the course of the stream.

In late Paleozoic time, following the peneplaination of the New England Alps composed of ancient Cambrian and Ordovician gneisses, granites, and schists, New England experienced faulting which produced the Connecticut "graben." Subsidence, well below sea level, permitted the deposition there of soft Triassic sediments which were simultaneously interbedded with trap rock. Elevation and continued block faulting in the Jurassic period combined with all the erosional agents to produce high relief. The continuance of erosive action resulted, according to Dr. W. M. Davis, in the production of an extensive Cretaceous peneplain. Later, in the Tertiary, elevation again enabled the streams to entrench themselves and at the same time to clean out wide lowlands in the soft rocks bordering the Connecticut.

As far as the Deerfield region is concerned glaciation exerted during the next period its most profound effects in the Triassic regions of Connecticut valley. Here it gouged out the soft Triassic sediment, in places, to depths below the present sea level. Compared to preglacial subaerial erosion the work of the glacier in the regions to the west was quite superficial, particularly in the north and west where harder rocks exist.

As a result of geologic structure and physiographic history the drainage basin of Deerfield River is conveniently divided into three physiographic regions: (1) The Triassic Lowland, (2) The Foothills, and (3) The Northwestern Highland (Figure 3).

THE TRIASSIC LOWLAND

The Triassic lowland occupies a strip about twelve miles long extending from Greenfield southward across the southern boundary of the valley. As a result of its physiographic structure and history this portion of the valley has, and can have, practically no value in the generation of hydroelectric energy, although it is the most densely populated and most important agricultural region in the valley.

THE FOOTHILLS

The foothills region is composed of phyllites more resistant than the Trias to the east. However, one can rarely see any connection between valleys and the durability of the bed rock. The drainage system, a heritage from the Cretaceous peneplain, was only superficially altered by glacial action. The course of the stream is interrupted at Shelburne Falls by the exposure of a hump of carboniferous granite of greater resistance than the surrounding phyllites. This outcrop accounts for all of the hydroelectric developments in the foothills region. Four plants of medium size occupy sites where the stream descends from the resistant formation to the less resistant bed rock farther east. Elevations vary from 200 to 1,500 feet above sea level. This foothills region forms the well dissected remnant of the extensive plateau which once extended to the east and west of Connecticut River.

THE NORTHWESTERN HIGHLAND

The northwestern highland is a region of youthful topography and deeply incised stream courses responding distinctly to the strike of the bed rock. Roughly it embraces the area of pre-Cambrian rocks as they are delineated on the geological map (Figure 2). The physiography of the highland is more plainly influenced by its stratigraphy and less by glacial action than is the case in either of the other regions. Here the main channel as well as the tributaries tend to follow the strike of the bed rock. The Deerfield makes its principal transverse passage at a point about six miles south of the Massachusetts-Vermont line where a fault deflects it from its normal course.

The stream experiences its steepest gradient in descending from the highland to the foothills (Figures 1 and 3). Between Harriman Dam, on the edge of the highland, and Station Number 5, located within the foothills, the natural course of Deerfield River experienced a fall of almost 600 feet. Modern power companies coming into the area discovered in that ten-mile stretch of rapids and falls a most valuable power resource. Three hydroelectric plants in tandem, with the aid of Harriman Dam which increases the height of the fall about 200 feet, utilize an aggregate head of 710 feet.

Flatter, slightly less dissected, portions of the highland permit storage of flood waters in two large reservoirs, providing excellent control of flow for the entire main stream. Glacial till is somewhat more uniformly thick and less eroded here than in the portions of the valley with greater relief, resulting in retarded run-off which aids in the control of flood waters.

Of the eight power plants on Deerfield River, only a single small one occupies a site in the highlands. Nevertheless the highland area is of inestimably great value to the entire Deerfield power system. As a consequence of its shape, size, and location it is a high-level catchment basin from which the carefully regulated stream is poured down through the series of turbines which the power companies have built.

Besides providing abundant head for the power plants, the shape and elevation of this catchment basin are conducive to the occurrence of heavier precipitation than is experienced in the lower parts of the valley. Somerset, at the head of the stream, elevation 2,080 feet, records an average annual rainfall of 51.2 inches, while Turners Falls at the mouth, elevation 200 feet, records an average of 39.4 inches.

The highland region comprises fully two-thirds of the drainage area contributary to the lowest plant in the Deerfield system. Thus, although the region actually produces very little power it controls the water flow for the entire system.

CLIMATIC AND HYDROGRAPHIC CONDITIONS

Deerfield valley experiences a modified continental type of climate. Its rainfall is heavier and more uniform than that of similar latitudes inland, and its temperatures are less extreme; but like the continental regions, its seasons are strongly contrasted and weather changes are frequent and marked.

Although seasonal and annual distribution of rainfall are relatively uniform (Figure 4), occasional extreme variations must be considered handicaps to power development. Exceptionally heavy autumn rains, such as those of November, 1927, result in torrential floods. On the other hand, an unusually dry season or year cuts water power production considerably and necessitates the use of steam power as a substitute. Steam plants are maintained in all New England power systems as insurance of proper service in case of low water.

An analysis of the actual month by month record for a strategically situated station provides the best portrayal of the

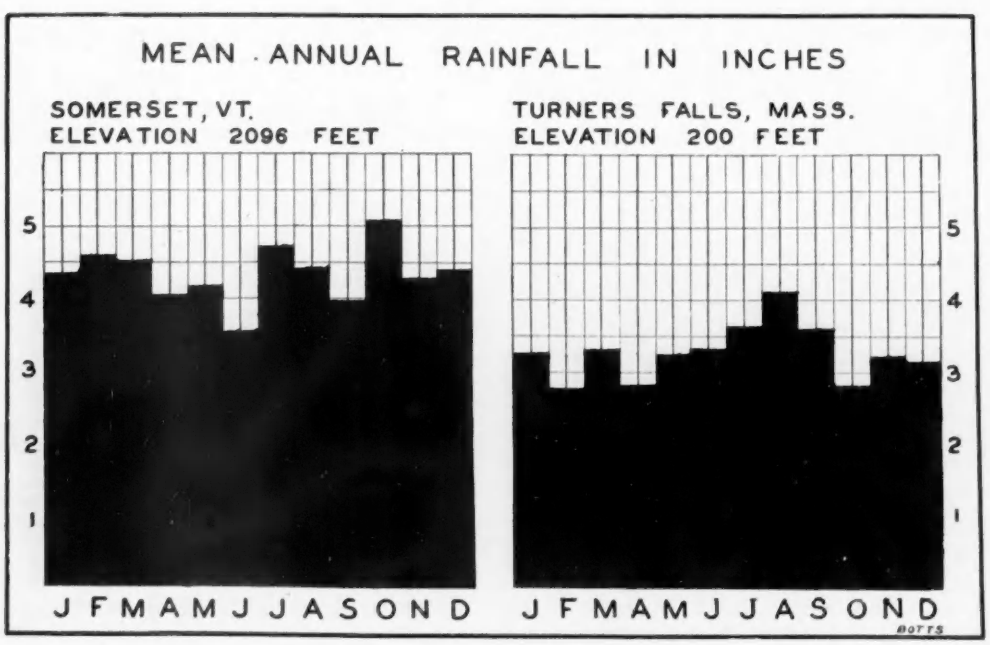

FIGURE 4.—Rainfall graphs of Somerset, Vermont, and Turners Falls, Massachusetts. Although both stations, one at the head and the other at the mouth of Deerfield River, have very uniform distribution of precipitation, that in the highland location receives on the average 12.5 inches more rainfall per year than does the lowland station.

TABLE I

MONTHLY RAINFALL, SOMERSET, VERMONT

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1911	....	....	....	....	....	....	....	....	....	....	3.51	4.04	.....
1912	3.39	3.34	4.60	4.03	7.04	2.96	3.82	4.18	4.94	8.04	3.62	6.36	56.32
1913	6.54	4.05	8.29	3.74	4.83	0.91	3.76	2.58	3.49	5.15	6.36	3.27	52.97
1914	3.44	3.22	4.55	6.10	2.35	3.36	3.92	4.64	0.91	2.82	2.94	3.25	41.50
1915	8.01	5.95	0.45	3.09	1.89	2.79	12.19	7.33	3.49	2.92	2.32	7.10	57.53
1916	4.00	5.18	4.71	4.70	3.94	4.40	4.46	2.20	5.22	2.52	5.56	3.80	50.69
1917	4.70	3.54	4.70	2.05	4.89	4.57	4.01	6.83	1.21	8.26	0.91	3.63	49.30
1918	2.38	5.33	2.79	3.04	4.19	4.12	2.30	3.73	6.10	4.27	2.32	4.20	44.77
1919	3.52	3.16	6.11	2.22	6.36	1.87	4.37	4.32	6.24	5.77	5.05	2.24	51.14
1920	2.56	6.93	4.28	7.49	1.94	6.70	3.96	4.55	4.11	6.08	9.41	5.56	63.57
1921	2.27	3.30	5.85	4.21	3.13	5.18	5.86	3.51	3.59	2.72	8.66	2.67	50.94
1922	3.39	3.49	6.15	5.67	5.54	6.53	2.23	5.43	2.35	2.13	2.87	4.45	50.23
1923	7.58	2.67	3.34	3.68	3.55	4.42	4.45	4.39	3.95	5.60	4.78	5.14	53.55
1924	5.51	2.43	1.25	5.51	6.55	2.58	3.88	4.24	4.77	2.09	4.29	3.01	46.11
1925	3.33	4.17	6.16	4.34	4.58	5.42	5.18	2.53	5.83	5.50	6.46	4.09	57.59
1926	2.29	4.70	3.38	4.37	1.35	4.99	2.27	2.95	3.55	4.91	5.38	2.71	42.85
1927	3.18	3.41	2.75	1.51	4.82	3.40	4.06	4.86	2.75	6.87	14.54	7.07	59.22
1928	4.81	3.55	3.95	4.79	3.66	6.20	6.38	6.03	3.55	2.50	2.18	2.69	50.29
1929	4.77	4.06	5.93	10.42	5.87	3.69	2.34	3.94	2.41	4.39	4.21	4.97	57.00
1930	4.09	2.65	5.39	2.20	5.58	4.97	4.39	4.11	3.22	1.92	3.69	2.18	44.39
1931	3.27	2.50	4.05	3.79	6.76	7.04	6.97	2.56	5.50	2.82	2.53	5.10	52.39
1932	8.01	2.85	5.16	4.76	2.48	4.12	4.22	5.93	2.44	7.58	7.34	2.56	57.45
Average.....	4.3	3.8	4.4	4.3	4.4	4.2	4.5	4.2	3.7	4.4	4.9	4.1	51.2

rainfall conditions as they really are. The rainfall record for Somerset, Vermont, is chosen for study because it has the longest record of any weather station that can be considered representative of the highland region. A highland station is chosen because it is the rainfall of that region which is most significant to the power plants down stream.

From the point of view of power production the following facts have particular significance:

(1) The absolute extremes of monthly precipitation are 0.45 inches and 14.54 inches occurring in March, 1915, and November, 1927, respectively.

(2) The driest year was 1914 with a total of 41.50 inches.

(3) The wettest year was 1920 with 63.57 inches.

(4) The total rainfall in the driest year was 65% as great as that of the wettest year.

(5) The two successive wettest years, 1919–1920, had 114.71 inches.

(6) The two successive driest years, 1917–1918, had a total rainfall of 94.07 inches.

(7) The total rainfall for 1917–1918 equalled 82% of the total for 1919–1920.

(8) March and April, 1915, were the two driest successive months, having a total of 3.54 inches.

(9) The two successive wettest months were November and December, 1927, with a total of 21.61 inches.

(10) The total for the two successive

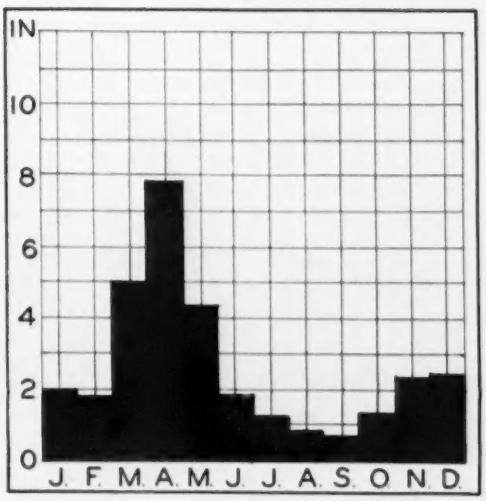

FIGURE 5.—Average annual run-off in inches, Charlemont, Massachusetts, 1913–1932. In contrast with the uniform distribution of precipitation in Deerfield valley as depicted in Figure 4, the excessive run-off of the spring months and the almost arid conditions of late summer afford striking contrasts.

driest months equals only 16% of the rainfall for the two successive wettest months.

(11) However, the rainfall for the two driest months is equal to 41% of the total for two average months.

(12) *Within the 254 successive months of record at Somerset, Vermont, sixty dry months but only four months of drouth have occurred. Their distribution by months follows:

TABLE II

DISTRIBUTION OF DRY AND DROUTH PERIODS BY MONTHS, SOMERSET, VERMONT, 1912–1932

Month	*Number of Times Dry*	*Number of Times Drouth*
January	4	0
February	5	0
March	4	1
April	4	0
May	5	0
June	5	1
July	4	0
August	5	0
September	6	1
October	9	0
November	7	1
December	6	0
Total	64	4

(13) Except for a greater frequency of dry months in late autumn their frequency distribution throughout the year is remarkably uniform. In view of the fact that October and November are the two months most subject to excessive precipitation (as a result of invasion of the region by tropical storms) it follows that those months constitute the period of least uniformity in precipitation from year to year.

(14) A study of the distribution of dry months by years tends to emphasize further the general dependability of rainfall in the upper Deerfield valley:

FIGURE 6.—One method of conducting water from the modern mill pond to the power plant. The water is conducted in this manner a distance of about two and one-half miles. An illustration of one type of topography to which a conduit provides an excellent adjustment. (Courtesy New England Power Association.)

TABLE III

DISTRIBUTION OF DRY AND DROUTH MONTHS BY YEARS, SOMERSET, VERMONT, 1912–1932

Year	*Number of Dry Months*	*Longest (Consecutive) Series of Dry Months*	*Drouth Months*	*Average Precipitation per Month During Dry Period*	*Precipitation During Driest Month*
1912	1	1	0	....	2.96
1913	2	1	1	....	0.91
1914	4	3	1	2.22	0.91
1915	5	2	1	2.34	0.45
1916	2	1	0	....	2.20
1917	3	1	1	....	0.91
1918	4	1	0	....	2.30
1919	3	1	0	....	1.87
1920	2	1	0	....	1.94
1921	3	1	0	....	2.27
1922	4	3	0	2.45	2.13
1923	1	1	0	....	2.67
1924	4	2	0	1.84	1.25
1925	1	1	0	....	2.53
1926	5	2	0	2.61	1.35
1927	3	2	0	2.13	1.51
1928	3	3	0	2.46	2.18
1929	2	1	0	....	2.34
1930	4	1	0	....	1.92
1931	4	2	0	2.68	2.50
1932	4	1	0	....	2.44

(15) Within the period of record, no dry period has endured more than three months, and even in the driest three months' period the average rainfall per month was 2.22 inches.

* It is arbitrarily assumed for purposes of comparison that three inches or less of precipitation in one month represents a dry month and that less than one inch in a month represents drouth.

(16) Three months' dry periods have occurred only three times in 21 years and two months' dry periods five times.

(17) At least one dry month occurred each year but the single occurrence of dry months is not a serious matter in view of the excellent artificial storage provided in the Highland.

(18) Even the months of drouth have not proven extremely harmful. Each one has been either preceded or followed by a month with more than average rainfall.

TABLE IV

RAINFALL OF DROUTH. MONTHS COMPARED WITH THAT OF PRECEDING AND SUCCEEDING MONTHS AT SOMERSET, VERMONT

Year	*Rainfall of Preceding Month*	*Rainfall of Drouth Month*	*Rainfall of Month Following*
1913	4.83	0.91	3.76
1914	4.64	0.91	2.82
1915	5.95	0.45	3.09
1917	8.26	0.91	3.63

SNOWFALL AND SNOW COVER

As a result of lower temperatures and greater winter precipitation in the highland region as compared with the two lower regions (Figure 4) snow accumulation in the highland is considerable. Before the construction of modern storage facilities the melting of this accumulated snow caused annual spring freshets of flood proportions. Since storage facilities have been provided the danger from spring freshets has been practically eliminated. That one-time handicap to power utilization on Deerfield River has been transformed into an asset. The waters from the melting snows are now caught in huge reservoirs from which they are poured into the stream as needed.

STREAM FLOW

Stream flow depends ultimately upon that portion of the rainfall which, evading evaporation, eventually reaches the stream course, some over the surface of the ground, but most by seepage through the soil. Variations in stream flow depend upon the size and type of the water shed, its physical characteristics, its climatic characteristics, and the degree of control to which it is subjected. Stream flow in its relation to rainfall and power use is commonly expressed as run-off. (Run-off is the depth, in inches, to which an area would be covered if all the water flowing from it in a given period were uniformly distributed on the surface.)

Figure 5 shows the average monthly distribution of run-off as measured at the government gaging station at Charlemont, Massachusetts. The outstanding characteristics of the distribution at this station are a distinct spring maximum enduring for the months of March, April, and May with its peak in May, and a minimum run-off in late summer, culminating at .85 inches in September. The spring maximum results from melting snows which have accumulated in the valley during the winter. But the reason for the summer low is not so obvious, especially in view of the normally high summer rainfall of the region. There are a number of contributing factors producing this condition, but the relative importance of all the various items cannot be ascertained here. High rate of evaporation due to the warm summer temperature and transpiration of an abundant vegetal cover, are the two major natural factors causing the low summer run-off.

The amount of water passing through the gaging station at Charlemont, Massachusetts, midway between the upper and lower groups of plants, is to a large extent regulated by the outflow from the two reservoirs on the highland. The degree of regulation at any period is influenced considerably by the demand

for power in New England's great power market. Furthermore, the current price of coal as it affects the economical production of electricity in steam plants is frequently a determining factor in the regulation of such isolated hydroelectric producers as those on Deerfield River. Thus it is apparent that the run-off, as it is recorded at the gaging station, does not represent the "natural" flow of the stream.

The item of storage is particularly important in the use of Deerfield River water. In its natural state run-off was exceedingly rapid, causing excessive spillage and waste of water at times of high water and almost dry channels during late summer and fall. As part of the modern system of power developments on that river, the two huge highland reservoirs have been provided to store the excessive run-off of flood periods and save it for periods of low water.

Miscellaneous Factors of the Environment

Deerfield valley lies wholly within the forested region of Northeastern United States; and although portions of the valley have been cleared, some of them several times, forests still occupy a major portion of the land. Most of the land thus forested is also very stony and consequently of no practical value agriculturally. As a response to the rough, stony, forested nature of the land and to the severe climate, population is sparse in that portion of the valley now utilized by power producing companies. The uselessness of the land for agricultural, commercial, or industrial purposes resulted in low land values, and made it easy for power companies to purchase extensive tracts of land at low cost, and gave them a great amount of independence in developing the latent power resources.

Water power, when produced as in Deerfield valley, in quantity far exceeding local demand, acquires the economic status of other raw materials of industry. It must seek distant markets and it must be able to meet keen competition from other contenders in its field. Although, from the standpoint of roads and railways, Deerfield valley is a distinctly isolated community, its chief product, water power, is easily accessible to the great power consuming centers of New England by means of high tension power lines.

Distribution of Hydroelectric Plants

The present day development of Deerfield River water power is almost entirely within the hands of a single power company. Except for one small plant at Shelburne Falls and two minor developments on tributary streams New England Power Company owns or otherwise controls the entire power rights of the river from its source almost to its mouth. Through the construction of two large reservoirs, the flow of the originally erratic stream has been completely regulated. Through the functioning of eight power plants of varying size approximately sixty percent of the fall of the stream has been put to work.

From the standpoint of location and geographic relations these water power developments fall into two groups. One of these, referred to as the upstream group of plants (See Figure 3), consists of the two reservoirs, Somerset and Harriman, and four hydroelectric plants, Searsburg, Harriman, Sherman, and Number Five, all properties of the New England Power Company. These developments are located in the higher portion of the stream course and bear a close relationship to the highland physiographic region. The reservoirs occupy distinct highland sites as does also

the Searsburg plant. The other three plants are important because of their location within the gorge through which the river makes its descent from the highlands to the foothills region.

All the plants are on the portion of the river which trends north-south in approximate conformity to the trend of the geologic formations. The fall in this portion of the river is a consequence of uplift by which means the stream has been rejuvenated. The bed rock, predominantly mica schist, is extensively exposed or thinly veneered with glacial till.

FIGURE 7.—A tunnel, conducting water from Harriman Reservoir two and one-half miles away, approaches Harriman Station directly through the mountain behind the power house and emerges at the surge tank, the large cylindrical structure in the background. Two switching yards are visible at the sides of the power house and the first two towers of the transmission line can be seen leading toward the right. (Courtesy New England Power Association.)

Almost the whole drainage area contributary to Station Number Five, is located within the highlands. All the other upstream establishments are located within that area. Less than ten square miles of the total 250 tributary to this plant lie within the foothill region. Viewed on Figure 3, the location of the main generating stations of this group emphasizes the function of the physiographic factor in this situation. The fan shaped area of rolling upland directs its stream flow towards a long, narrow, steep sided corridor through which it has access to the much lower foothills region. This narrow corridor seven miles in length and about ten square miles in area contains three of the four plants of this group. These three plants, Harriman, Sherman, and Number Five represent 684 of the 914 feet of head developed in the four plants. They possess 89,000 of the 95,700 horsepower capacity of the four upper plants and thus represent seventy-five percent of the total developed capacity of Deerfield River.

This concentration of seventy-five percent of the developed capacity of Deerfield River, within a section of a physiographic region containing less than two percent of the total developed drainage basin indicates the tremendous significance of the break between the highlands and the foothills.

Efficient utilization of the power resulting from rapid descent to the foot-

hills has been made possible by almost complete control of the water before it leaves the highlands. It is obvious that water stored on the highlands has greater power potentialities than the same volume stored in the foothills or lowlands. From an elevation of 1,400 feet Harriman Reservoir controls power operations down to the lowest station at elevation 125 feet (N. E. P. Co. Datum).

The other stations, referred to as the Shelburne Falls group, located at a point about eighteen miles downstream from the others, owe their location to an outcrop of carboniferous-diorites which have resisted erosion and thus created about 238 feet of fall within a distance of eight miles (Figure 2). These plants are Numbers Two, Three, and Four belonging to the New England Power Company, and the Gardners Falls station belonging to Greenfield Electric Light and Power Company. The four stations at Shelburne Falls use completely the fall of water from the crest of the dam at Number Four Station, elevation 368 feet, to the tail water of Number Two at elevation 125 feet.

Thus, at elevation 125 feet, is completed the work of the water of Deerfield River after passing through hydroelectric generating equipment capable of producing 129,000 horse power of electric energy. Much of this water has its source in Somerset Reservoir at elevation 2,048 (N. E. P. Co. Datum) from which it descends 270 feet before starting its work. At Searsburg pond it is first harnessed (Figure 6), and used in a descent of 230 feet. After leaving Searsburg tail race the water descends only twenty-five feet before it is again caught and put to work, this time in the huge Harriman plant where 361 feet of fall are utilized (Figure 7). From Harriman plant the water passes almost immediately into Sherman Station's pond and thence without rest to Number Five Station. In those two stations it works throughout a total 315 feet of fall.

Number Five Station empties it back into its old channel where it is permitted to proceed unused but controlled in flow for a total descent of 315 feet distributed over a horizontal extent of 17½ miles. There the water, together with additions from various tributaries, is again put to work at elevation 368. Through the agency of four separate plants every available foot of its fall for the next 243 feet is utilized. Since leaving its source in Somerset Reservoir the water has descended a total of 1,908 feet of which 1,135 feet (59%) have been spent within the confines of one or another of the eight power plants in its course.

A DISTRESSED INDUSTRIAL REGION—TYNESIDE

George H. J. Daysh

THE purpose of this paper is not so much to provide the purely economic aspects of a region, world famed in many respects, but now suffering acutely from depreciation in its industrial activities, as to form a statement from the geographical viewpoint indicating the particular geographical elements that have played and continue to play a part in its modern industrial character.

Tyneside has been earlier defined by Dr. Mess in *Industrial Tyneside*. The area covered by this term may be briefly described here since in so doing both the characteristics of the region and the justification for the area incorporated may be made clear. Furthermore it must be stressed that considerable change has occurred since the date of publication of the work and there has moreover been carried out an intensive study of the North East Coast region as a whole. There is room therefore for a brief outline of a geographical character dealing with the present core of the whole industrial region of northeast England.

The word Tyneside links up for this purpose sections of the two counties of Northumberland and Durham on the north and south banks of the Tyne. The real problem is the actual extent of area north or south that may be rightly included. The western limit is much more easily and soundly arrived at since, as will be shown, there occurs a distinct break in industrial expansion up the river. The physical character of the Tyne in its lower reaches emphasizes and yet explains the problems of north and south boundaries. An earlier description of the river exists by Sargent, who points out the essentials of the topography which have largely produced the particular character of settlement grouping in the region. In many places the banks rise steeply from the immediate river vicinity. Very little space is naturally available along the river side. Both lateral growth and growth up and over the enclosing higher land have occurred. The north and south expansion over the crests is certainly closely related to the riverside industrial activity. The problem is where Tyneside industries end and the independent activities, less closely related in the direct sense to the waterway, begin. The degree of dependence upon the waterway is not easy to define. The linkage of water and land transport forms make for the considerable unification of a large area to the river. The difficulties are apparent and the solution generally accepted is arbitrarily based. For general purposes the north and south limits may be regarded as the boundaries of the municipal areas named on the accompanying map.

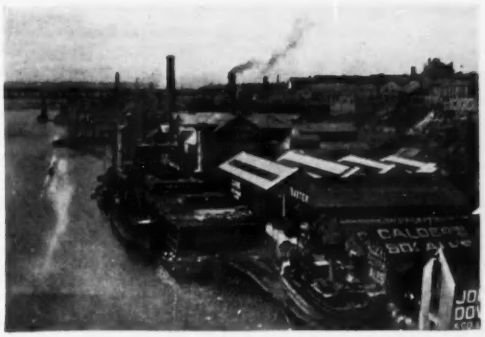

FIGURE 1.—A view of the North Bank of the Tyne immediately west of the High Level Bridge. The narrow rim of low-lying land, with the steep rise behind, can be appreciated.

These areas form one large industrial

region, by no means completely unified but each necessarily endeavoring primarily to serve the interests of its own community and with the river itself as a divide between the two county zones. A unification of these areas has been suggested in a recent report by the Government Commissioner, Capt. E. Wal-

FIGURE 2.—Looking west from High Level Bridge. Sections of both banks are shown with the south side's steep ascent evident.

lace. Included in this zone must necessarily be those regions which are intimately associated through their status as residential or dormitory zones. Thus the coastal region of Whitley and Monkseaton, unified with the industrial and commercial centers by rail and road services, and the Gosforth urban district, more particularly a residential area for Newcastle itself. The western limit imposed by this map is relatively clear and concise in regard to the present characteristics of the area. The tidal limit of the Tyne is in the region of Wylam, some 19 miles inland, but from the point of view of navigation the limit is rather nearer the sea. There is a double aspect in this case in that while the river is economically navigable to Newburn, the presence of the Scotswood Suspension Bridge, with its clear headway of only 17½ feet at H.W.O.S.T. is undoubtedly a bar to penetration by shipping in the upper section. A scheme for the replacing of this bridge has recently been considered, the proposed new bridge being less of a barrier than the existing one. In this upper section the low lying flats or haughs at the Derwent mouth and westward in Newburn and Ryton haughs, provide some definite degree of space for industrial activity immediately fronting the river. But as yet industry lines the river and has not spread on to these lower somewhat ill-drained areas. The lower Derwent area has however become more intensively used by reason of the establishment of the activities associated with the Consett Steel and Iron Company and in so doing there has developed a more obvious and definite link between Tyneside proper and the Consett Steel center, virtually the only steel works surviving in the immediate Tyneside region now that the major activities in that respect have been gradually concentrated in the Tees-side

FIGURE 3.—The new single span Tyne Bridge (opened October 1928) with Swing Bridge (opened in 1876) in the foreground. The Tyne Bridge has a headway of 84 feet H.W.O.S.T., while the width of the two channels under the Swing Bridge are 101¼ feet and 97 feet on north and south sides respectively.

region of the North East Coast. Apart from this recent addition of Tyneside interests little or no progress has occurred above the Derwent confluence to Newburn, the inner limit of the Tyneside zone. Despite the internal complexities, natural and artificial, this region is to be regarded as the Tyneside zone, the center of economic activity on

the North East Coast, the major concentration of population in the area, totally some 800,000 people, and with Newcastle as the major site of all in northeastern England.

It is apparent that the waterway is the real link or core of the region. Access to this waterway is possible, but not always easy, over a 19-mile stretch of industrial interests. The need of access is seen in the considerable use of the physically controlled fringe and now the banks are very fully covered. The covered space is not however entirely in economic occupation or activity and the east-west belt of settlement encloses evidences of past rather than present activity of the types that have become recognized as particularly those of Tyneside. These activities are, however, very closely associated with the waterway. The real physical character of this portion of the Tyne requires appreciation. In its natural unaltered condition the waterway was by no means ideal. There was need of considerable improvement to fit it for the purposes of the specialized industrial and port activity. The improvements have been almost entirely due to the activities of the Tyne Improvement Commission—a body that may be regarded as one of the centralizing and unifying elements in the economic framework of the zone. The Commission consists of 36 representatives of the several interests of Tyneside and succeeded the Newcastle Corporation as the controlling body in 1830. By the constitution of the Commission the balance tends to be maintained and the claims of the respective centers related. The river has been very definitely altered during the period of control. Several problems had to be faced in the early period. Access to the river was restricted by shallowness and by the exposed character of the mouth. The construction of piers served to direct the ebb and flood streams so as to remove the old bar, and to provide shelter for incoming and outgoing vessels. To make and maintain an effective navigable channel within the piers was also necessary. The position now is that from the piers to the Northumberland Docks, some 3¼ miles, the river is dredged to 30 feet at L.W.O.S.T. This is a considerable modification of the natural state, when for instance the depth of water over the bar was only 6

Figure 4.—Typical staiths for coal discharge by gravity flow on south side of river with Scotswood works of Messrs. Vickers Armstrong visible on opposite bank.

feet at L.W.O.S.T. in 1860. With a tidal range of 15 feet at Newcastle and slightly less at the river entrance a necessary navigable depth has been secured. Regular dredging is still necessary, nearly two million tons being taken up annually. The suitability of the channel thus evolved, from the point of view of depth alone, is represented by the fact that such vessels as the *Mauretania*, built on the Tyne and drawing over 32 feet of water, have used the channel.

Width of the river must be borne in mind and generally the waterway is much more restricted in this sense, and also it is by no means a straight channel. From bank to bank the river is in many parts but little over half a mile. Between the quays at Newcastle the width is only some 374 feet. The greatest width occurs about two to three miles

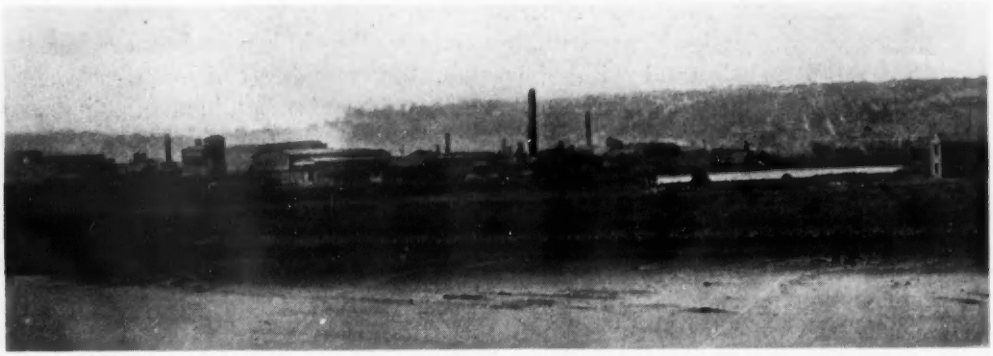

FIGURE 5.—Looking south towards Blaydon where greater width of low land lies within the high flanking crests. The housing growing up and over these crests is discernible in the background.

from the entrance where the low lying region of Jarrow Slake occurs, the outlet region of the River Don. Much of this remains as negative area, but one of the three wet docks, namely Tyne Dock, belonging to the L.N.E.R. has been constructed in the area, its purpose being essentially coal handling. Tyneside's other major interest, ship construction, is represented in series of yards along both banks further inland in the narrower zones. The effect of the topographical control as represented by lack of low lying land and the narrowness of the waterway is reflected in the fact that these yards are not at right angles to the waterway, but frequently at some 45°. Dry docks are also similarly placed.

The limited amount of wet dock accommodation and the location within one region of those in existence is again a clear reflection of the physical controls. The three wet docks, Northumberland, Tyne Dock, and Albert Edward are located in the lower wider reaches just within the narrow congested mouth. Above Northumberland Dock, wet dock construction is well nigh impossible by virtue of the difficulties implied by the topography. Fortunately the tidal range over the dredged channel is such that their construction is not vital and it has been possible to concentrate upon the policy of riverside quays over the major proportion of the navigable reaches. Independence of quay construction has meant, however, considerable variation in the nature and effectiveness of such quays.

It is apparent that this waterway, whilst having greatness thrust upon it, has exercised some dominion over the concentrated industrial activity. The character of the region, its cultural landscape, has been determined by the underlying physical controls. Numerous factors have contributed to a high degree of industrial and economic specialization. Tyneside is primarily concerned with coal export, ship construction, marine engineering, and ship repairing. Other interests are associated and subsidiary. A particularized quality of economic organization has been evolved. Today the position is that in the major interests there has occurred decay.

Naval and commercial shipbuilding output from the Tyne has dropped significantly while the coal export trade has also suffered. The waterway and the narrow fringe surrounding the waterway have been over a period of years modelled to these forms of occupation. Railways throw out their tentacles from loading points on the river to the surrounding pitheads. Ship yards and their accompanying paraphernalia line sections of the riverside, particularly in

the municipal areas of Wallsend, Jarrow, and Hebburn each of which developed around a shipbuilding concern, Messrs. Swan, Hunter, and Wigham Richardson, Palmers Shipbuilding Company and Messrs. Hawthorn, Leslie, and Company respectively. Jarrow particularly is a shipbuilding center and little else, which accounts for its exceptionally distressed condition today. In the eastern portion of Newcastle itself occur further concentrations, especially the St. Anthony's section of the river border.

The extent to which the shipbuilding interests of the area have been affected may be represented by the following facts. Figures, taken from *An Industrial Survey of the North East Coast,* show that over the period 1927–1930 the world tonnage of merchant shipping launched was 1.6 per cent less than that of the period 1910–1913. The decrease for all ports of Great Britain and Ireland was 14.3 per cent, for Blyth and the Tyneside area there was a decrease of 10 per cent.

This, though greater than the drop of the Clyde tonnage, was much less than the drop in the other ports of the North East Coast. The Tyne specialization in oil tankers gave it a better position and result than its immediate neighbors. But the drop is significant. The facts relative to warship tonnage complete this aspect. The average annual warship tonnage built on the Tyne over the period 1907–1913 was 32,503 displacement tons. Over the seven years 1924–1930 the average annual tonnage built was 12½ per cent of the pre-war period quoted, which represents a greater percentage reduction than that for the country as a whole. The reaction upon the occupied population will be appreciated

FIGURE 6.—View of Tyne Dock (London and North-Eastern Railway) looking north. The grouping of coal staiths and the method of coal discharge are apparent. To the west, just outside the photograph lies the Jarrow Slake area. (Courtesy of "Evening Chronicle" Newcastle.)

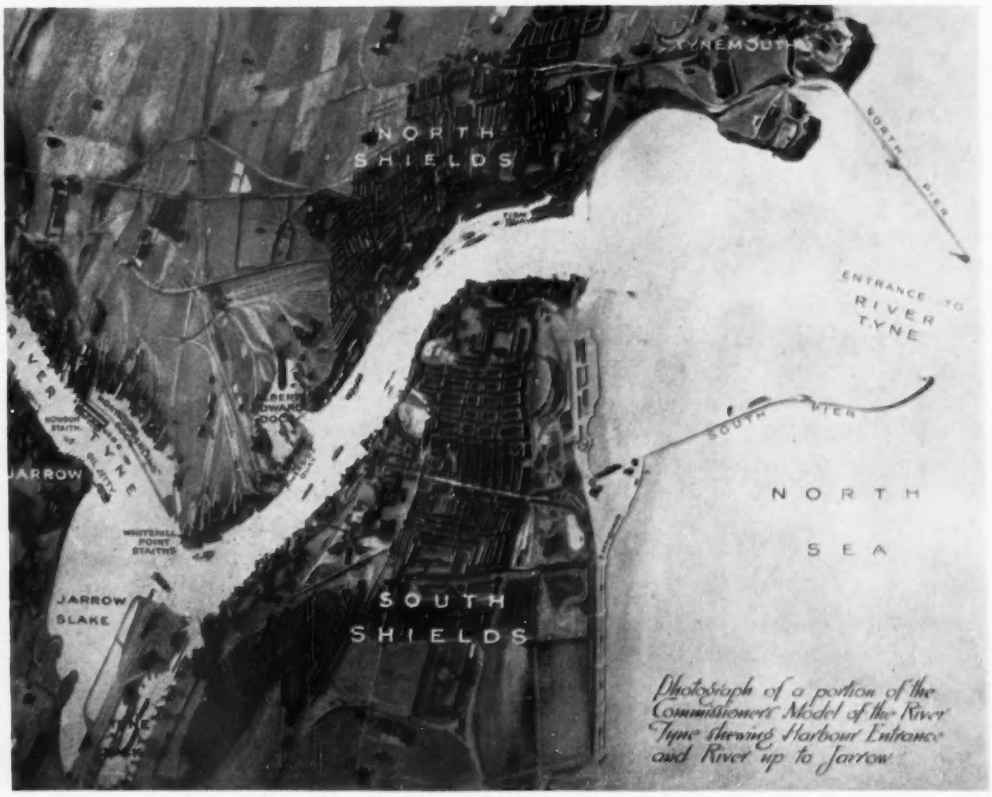

FIGURE 7.—The essential characteristics of this portion of Tyneside are well brought out by the photograph and the contrast between the greater width of the Jarrow Slake section and the western reaches is evident. (Courtesy of The Tyne Improvement Commission.)

when it is realized that in Jarrow, Hebburn, Newcastle, and Wallsend, the largest group of occupational forms is that of metal working which is essentially concerned with the shipbuilding and ship repairing activities.

The decline in the coal export trade has been a further blow to this region. Domestic coal consumption has hardly changed, but in 1933 the coal and coke shipments from the Tyne were over 7 million tons less than in 1913.

Consequently this intensive grouping of population has experienced a distinct change of status, to some extent due to circumstances over which it had no control. It has in the difficult period preserved its status as the hub of the North East Coast despite the almost complete loss of its chemical industry to the Tees-side region. There are few industries in the area other than those bound up with shipbuilding, ship repairing, and engineering. Occupations associated with chemicals, glass, pottery, and so on, some of them old established trades, as P. Pilbin has described in his geographic analysis of the sea-salt industry of northeast England, published on page 22 of the *Scottish Geographical Magazine*, Volume 51, No. 1, January, 1935. The alkali industry of which he writes has now almost vanished from Tyneside, the major chemical works of northeastern England being concentrated in the south Durham region, have been in the past obliterated by the development of the basic industries. There is little or no reason other than this that they should not have either survived or developed to

a more significant degree than today but there are few chances for their development now. The relatively narrow range of production persists, a broadening is possible, and to some extent has taken place, but the region is so modelled and has been so definitely moulded that significant changes appear unlikely. Its hopes, apart from conditions leading to increased armament productions, rest upon a general increase of world trade in which it must have its share. So far as its particular specialized forms of trade are concerned, there appears no reason why it should not effectively obtain this share, provided that its economic organization allows it.

The changes in the economic condition of Tyneside and the North East Coast area as a whole are reflected in population data. An examination of this data was made in *Industrial Tyneside* and it was pointed out at that date that the Tyneside region had been "piling up a population for which adequate employment is scarcely likely to be forthcoming." An investigation of population figures as given in this volume, later continued in *Tyneside Papers*, No. 1 ("The Trend of Population on Tyneside," February, 1931; Tyneside Council of Social Service), and further continued in this paper, illustrates the position as recently as it is possible to obtain full information. The facts up to the middle of 1932 can be arrived at and may be expressed in the following manner.

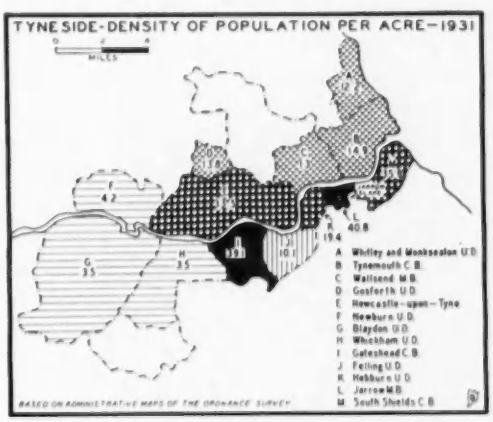

FIGURE 8.—The concentration of population in Tyneside follows very closely the distribution of the major industries. The high density of a few areas contrasts strongly with the relatively small density of adjoining areas.

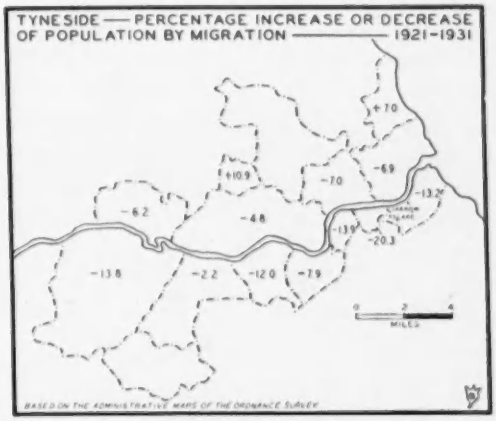

FIGURE 9.—Decentralization of population follows diminution in industrial activity.

Between mid-1921 and mid-1926 there was a steady decline in the number of births in the Tyneside region, while the death rate remained very much the same. During this same period there was very slight movement of population out of the region, the average annual loss by migration being only 1,886. From 1926 onwards, however, the position changed in a very definite manner. The births continued to slightly decline, the deaths remained much as before, but outward migration became very apparent. During the period mid-1926 to mid-1929 there was an outward flow of a total of 35,164 persons, an average of over 11,000 a year. As is stated in the Tyneside paper referred to, the year 1926 opened a good many eyes and destroyed many false hopes. Furthermore the Industrial Transference Board and other machinery came into operation in assisting and organizing migration. Between mid-1929 and mid-1932 that outward flow has continued, but inevitably at a slower rate. The total outward

flow of this latter period has been 21,895, an average annual loss of over 7,298 persons, approximately two-thirds that of the 1926–1929 period but four times that of 1921–1926. The average annual outward flow is greater than the figure of natural increase of population for the area which latterly averages some 5,000.

It is clear that this Tyneside region is adapting itself to the new status, but too

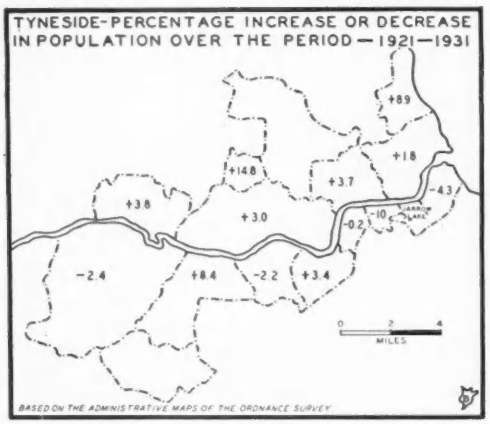

FIGURE 10.—The migration of population is more evident in the percentage increase or decrease than might be expected and offers interesting contrasts to the general change in population density as indicated in Figure 9.

slowly to cure its present distressed condition. Population migration of this type is also apparent for the two county areas of Northumberland and Durham. It is a characteristic of such areas as South Wales as well. While this outward flow has gone on in this northeast region there has been a considerable addition to the population of southeast England by inward migration, amounting over the last six years to an average annual addition of over 85,000.

The Tyneside region has not as yet experienced a revival in its major or staple industries. It has gained but little by the growth and establishment of light industries in the country. The cure is partially taking place by the migration of its population. This outward flow is not uniform of course throughout the whole northeast region. For example the Tees-side area has experienced an average annual inward flow of some 3,000 persons over the period mid-1929 to mid-1932. This may be chiefly associated with the stimulus given to the region by the establishment of the chemical activities at Billingham, which resulted in a doubling of the population over the period 1921–1931. This internal change is disguised by the facts for the county of Durham as a whole, in which over the same 10-year period there has been a 10.5 per cent increase of population due to excess of births over deaths, but a 10 per cent migration, giving a total increase of population of only .5 per cent as revealed in the county of Durham census, part one of the Census of England and Wales, 1932. What is the characteristic of Tyneside is equally characteristic of the region as a whole of which it still remains the central core.

To relieve the distressed conditions of much of the northeast area including the Tyneside region various methods are under consideration. Briefly four things seem possible and are being tried, namely to revive old industries, to establish new, to promote schemes of land settlement and finally to promote further labor transference. All have their attendant difficulties and meanwhile transference goes on through migration.

Emigration from the country is no solution at present and the facts show that more people are coming into the British Isles than are going out at the present time, as judged by the figures for immigration and emigration. The problem is acute and though some alleviation has occurred it would seem that for some period there will be a heavy burden for the area to carry in the form of the unemployed surplus.

CULTURAL ADJUSTMENTS TO THE MESABI RESOURCES

Paul H. Landis

IT IS difficult to strip a geographical area of its cultural super-structure in order to see it in its purely natural aspects. Once culture building begins, the setting may be radically changed, especially where the culture building group is possessed of technological devices capable of controlling nature to a considerable degree.

The Mesabi Iron Range lies in northeastern Minnesota, some sixty miles northwest of the west end of Lake Superior. A survey of the history of the people who have inhabited the region indicates that different groups have utilized different natural resources. For instance, one group has sought wild game, another tillable soil, another minerals. The natural environment has been relatively constant for several centuries, consequently, all present resources have been available to previous groups. Yet, each group has specialized in exploiting a selected resource. This fact merits an explanation.

Resources of the Mesabi

From our present knowledge, however, it appears that the original resources of the Mesabi Range were: (1) *Flora,* a virgin forest, principally pine; undergrowth with fruits and berries in great abundance; pin cherries, choke cherries, June berries, raspberries, strawberries, huckleberries, and blueberries; (2) *Fauna,* moose; bear and deer; many small game animals and furbearing animals; waterfowl and freshwater fish abounding in the lakes; (3) *Soil,* a fertile and well-watered soil, but rugged and rocky, in places swampy, and everywhere so covered with trees that roots forbade tillage until they had been removed; (4) *Minerals,* vast beds of iron ore that lay near the surface in loose formation.

Early Uses of the Mesabi

The Mesabi district was the possession of the Chippewa (Ojibway) Indians until January 1, 1855. The native tribes lived chiefly by hunting, using wild game and berries for food. Theirs was a hunting culture. Agriculture as they practiced it was of the most rudimentary sort. Nor did they make use of the white pine or the iron ore that has meant so much to the white man.

Missionaries seeking to Christianize the Indians, and fur traders seeking pelts were the first white visitors. They did not come as did later immigrants, to make homes or settlements, or to conquer the environment.

The Range remained without permanent settlements until the development of mining. A gold rush to the Vermilion Range in 1865 took large numbers of travelers through the district, but these men sought gold—they would probably have had no interest in iron ore even though they had known of its existence.

Lumbering reached its peak on the Mesabi about 1880 to 1890. The lumbermen saw and sought only one resource—pine. The land to them had no other meaning; timber rights were their only concern. Mineral rights were not considered in acquiring the land or in disposing of it after it was stripped of its forests.

Lumbering in the Lake Superior region was carried forward on a large scale. In the early days tremendous loads of logs were hauled in these north-

ern forests. Massive sleds loaded with logs traversed areas in winter over which it was impossible to travel in summer by any type of vehicle. An early observer viewing the forests in what is now the Virginia district thought there was timber enough for hundreds of years, but it was gone in twenty-five or thirty years. An extensive strip of virgin timber near Hibbing, believed by early explorers to be inexhaustible, was completely gone in fifteen years after the beginning of the lumbering operations.

FIGURE 1.—Lumbering early became an important industry of the Mesabi, reaching its maximum development in 1880–1890. The one tree that constituted the basis of the industry was the pine, and within a few decades it had all been felled.

Long before the opening of the Mesabi, lumber had found a place in the American culture scheme. The exploiting of the Minnesota supply was only a stage in the western quest for pine.

Lumbering had its beginnings in America in the East. New England led in the early days, New York state in 1850, and Pennsylvania in 1860. Then came Michigan, Wisconsin, and Minnesota in rapid succession, so that by 1924 only three per cent of the original timber supply of these states was left. For the last twenty years the South has been the chief source of timber supply, and now less than 20 per cent of its original supply remains. At the present time one-half of the saw timber of the United States remains in the three Pacific Coast states.

Lumbermen left behind only the ruins of their exploitation—stumps, underbrush, and burned-over areas. They did not build a single city of permanence in this forest, not even a permanent dwelling. With the passing of lumber they, like the "lumber jacks," migrated to virgin supplies in the West, or turned to other enterprises in nearby cities. Many timber barons allowed the land to revert to the State to avoid taxes, or sold it for what they could get.

DISCOVERY OF MESABI ORE

Little did the lumbermen know that beneath the roots of the pine stumps they left behind lay buried treasures greater than the entire timber wealth of the nation. Some learned it to their chagrin after having disposed of their land holdings for a pittance; others who held their land because of inability or indisposition to dispose of it learned of its value to their permanent advantage.

As early as 1850 iron ore had been discovered on the Vermilion Range (some 60 miles north of the Mesabi), by J. G. Norwood. A geological survey in 1864 led to the discovery of the Soudan Mine on the Vermilion Range. As early as 1866 Henry H. Eames, in quest of gold, located iron ore on the Mesabi Range. Peter Mitchell verified his discovery in 1869–1870. Not until 1892 did a railroad reach this range to inaugurate the shipment of ore.

FIGURE 2.—The Buffalo Mine at Hibbing, Minnesota. With the discovery of the rich iron ore deposits in the Mesabi, one of the richest deposits ever found in the world, and so easily accessible that it was stripped off with steam shovels, mining became an industry of primary importance.

Never before in the history of the world had so rich a bed of ore been located. Moreover, it was found in a loose form, and very near the surface so that mining by stripping with the steam shovel was first employed here. The steam shovel made possible an output without precedent.

This ore apparently had lain undisturbed for centuries. It was potentially a resource of all previous peoples that had inhabited St. Louis County. It was, however, never made an active factor in any previous culture. Why did this resource take on meaning at this time? This question is to be answered only by understanding the impact of a machine age on natural resources.

THE MESABI IN AN IRON AGE

England led the world in iron production in the nineteenth century. Extensive ore discoveries brought America to the place of leadership in the twentieth century. The most important of these was the discovery of the Mesabi deposits.

In 1929 the United States produced 72,199,815 metric tons of iron ore. In the same year France produced 51,028,000 metric tons, Great Britain 13,427,043 metric tons, and Sweden 11,000,000 metric tons. The leadership of the United States not only began with the development of the Mesabi Range but has been maintained by its annual production.

Before 1820 the per capita use of iron in the United States was 40 pounds. This grew to 175 pounds by 1870, and to 400 pounds by 1900. Whitbeck and Finch state in their Commercial Geography that "one corporation in the United States now markets more iron and steel

yearly than all the world used in any year prior to 1880. But a century ago iron was a luxury—now it is an 'industrial commonplace.'" In 1907 twelve hundred pounds of ore were used for every person in the United States. Iron has become in a real sense, the measure of civilization in our age. Steel making peoples now dominate the world, and leadership among nations depends upon iron resources.

The iron ranges represent the Industrial Revolution at the raw-materials-end of the process. Activities at the mines represent the first process in steel production. The other end of the process, that of manufacturing the raw material, may be seen at Pittsburgh and other cities. The Range is thus tied up with the commerce and industry of the nation.

The development of the Minnesota Range was a step in the westward trend of the iron industry.

Charcoal was employed in the smelting of iron until about 1850, when anthracite coal came into use. This development led to a great increase in ore production in America, and the industry became centered in the anthracite district of eastern Pennsylvania. By 1875, the use of bituminous coal led to a shift of the ore smelting district to western Pennsylvania and the upper Ohio Valley.

Railroad development during the Civil War period gave the iron industry a great impetus. Soon after (1884), the first ore from the Lake Superior district was shipped. Gradually the ore trade and ore smelting shifted toward the Lake shores. A large steel plant was developed as far west as Duluth and coal for smelting was shipped to the ore, replacing the usual process of shipping the ore to the coal.

The shifting areas of ore production follow the same general trends as do those for ore smelting. In 1899 New York state mined 1,247,000 tons of ore. By 1911 this output was reduced to 1,000,000 due to the competition of Lake Superior area more than to exhaustion of supply. In 1890 Pennsyl-

FIGURE 3.—The rapid depletion, and the impending exhaustion of the iron ore resources of the Mesabi, and the lumber supplies long ago exploited, the Mesabi must turn to new sources of materials for any further development. The scenic and recreational possibilities of the region are indicated by such a view as this of one of the thousands of lakes in the region.

vania led in the production of ore; by 1911 it held seventh place. The same year Michigan and Minnesota produced more than three-fourths of the ore of the United States. In fact, during that year they produced more ore than the entire United States had produced in 1889. The first shipment from Michigan ranges was in 1856, from the Vermilion Range in Minnesota in 1884, and from the Mesabi in 1882. By 1900 the Mesabi Range was shipping over one-fourth of the ore of the Lake Superior district, by 1914 almost one-half, and by 1916 about two-thirds. It has been shipping about two-thirds of the Lake Superior ore even to the present time.

The Mesabi Range came to the attention of the iron men just at the time when inventions for smelting ore with soft coal had reached the place where ore could be profitably mined in the lake district. The time of the discovery was, then, fortuitous. It solved, to a great extent, the problem of raw materials for a rapidly expanding industrial civilization with iron as its basic material culture trait. This industrial need gave meaning to the previously unutilized ore bodies.

LOCATION IN RELATION TO INDUSTRY

The resources of the Mesabi have been of first importance to contemporary man. Next in importance, probably, has been location with reference to the heart of American industrial life. We have seen that industrial life gradually shifted westward with the development of techniques for smelting iron by the use of soft coal, until the industry was centered in the bituminous coal regions of the lower lake states. Ore is bulky and the transportation costs are important items in determining the value of a deposit. The location of the Mesabi near the shores of one of the Great Lakes is of the greatest importance.

Ore has been profitably hauled on the Great Lakes from the Mesabi Range to Pittsburgh, a distance of approximately one thousand miles. It is only sixty to eighty miles by rail from the various mines of the Range to lake ports. From these ports ore goes to the lower lake ports by boat and is reloaded on trains and sent to the coal districts for smelting. There is a disadvantage—loading and reloading—but such efficient machinery has been developed that this handicap has been largely overcome. In fact, the ore handling equipment of the Lake Superior district is known as the most efficient in the world.

At Duluth the ore is dumped from ore trains into dock bins, and from the bins into ship holds. At the lower lake ports it is also automatically unloaded, and reloaded on the ore trains which carry it to the iron smelting cities. The railroads are exceedingly economical since they are used almost exclusively for ore and can carry the maximum traffic. The loaded trains can coast most of the way from the Mesabi Range to Duluth.

If it were not for these advantages in the way of water transportation and efficient handling, it is doubtful whether the Mesabi ore could be hauled with profit more than half the distance. The Mesabi ore no longer competes successfully with Cuban, Chilian, Newfoundland, Spanish, and Swedish ores in the eastern cities, but so far these cities have not been important competitors.

THE UTILIZATION OF OTHER RESOURCES IN THE ENVIRONMENT

The range cities, recognizing that ore is an exhaustible resource, have tried to plan for the utilization of other resources that will make for an enduring future.

Tourists have in recent years been attracted to the north country during

FIGURE 4.—An abundance of fish in the lakes and streams, and of game in the surrounding forests, make the Mesabi an attractive region for the sportsman.

the summer months. While this seasonal trade stimulates business, it cannot assure permanence to the community. The natural resources upon which it depends are also exhaustible. Fish and game, scenery and climate, are the drawing cards. Fish and game conservation measures have to be enforced increasingly to preserve wild life for the future. Cottages and clearings are already marring the landscapes in some sections. Climate will, doubtless, always be an attraction in summer months.

Probably the most permanent type of community can be built around agriculture, for the soil if properly used is inexhaustible. The range towns have recognized the importance of agriculture and have for some twenty years tried to encourage its development. Many Finnish families have turned to agriculture during periods of industrial inactivity or strife, and some have succeeded in making a fair living from the soil, despite the short growing season and the ruggedness of the surface features. One can hardly hope that agriculture will be developed sufficiently to support the towns with their present populations.

SUMMARY

It is clear that the Mesabi, though its resources now appear to be limited largely to ore, has, in the past, provided for other types of adjustment. For the Indian it was a hunting ground; for the lumberman it was a country to exploit and abandon; for the present generation it is a land of permanent settlements where man can live by mining ore; for the Finn it is a land where agriculture is possible; for the tourist it is a paradise of lakes, fish, scenery, and climate—a place where he can find recreation and rest.

The adjustments made by each group have depended upon its cultural possessions. The various natural resources of the Mesabi have taken on meaning to resident groups only as their culture patterns have been able to utilize them. For this reason, the resources one group has despised, another group has cherished.

There is no question that ore is the only excuse for the present cultural superstructure in the Range cities, and that much of the material and non-material culture is simply an adjustment technique fitted to this particular natural resource. It is also clear that upon the exhaustion of ore the present social order must disintegrate, or make adjustments that cannot now be foreseen in detail.

The effect of the cultural impact upon the Range is everywhere apparent, as a testimony of man's power to dominate phases of nature and give them meaning in his mode of life. The barren landscapes stripped of timber testify to man's power to exhaust a resource and leave nature as naked and worthless to human industry as a passing hurricane or glacier could have done.

CENTRAL FLORIDA FARM LANDSCAPE*

Samuel N. Dicken

FROM Tampa northward to the Georgia line stretches the pitted limestone backbone of Florida, the Florida karst. Long recognized as a region distinct from the Gulf "hammocks" (hardwood forests) to the west and from the "flatwoods" to the east, this area includes the highest points in peninsular Florida. The surface may be briefly described as a very subdued karst, in which the usual forms are shallow, concave basins and low, rounded hills, a thick cover of sand masking any irregularities which might otherwise appear. Small streams are almost entirely lacking, but there are a few larger streams, a number of small permanent lakes, and, in many of the solution depressions, a large number of intermittent ponds. Nearly all of the higher land is covered with long leaf pine and the lower parts of the basins are in savanna, hardwood, or swampy vegetation. In central Florida, south of Orange Lake (Figure 1), the region was settled less than a century ago. It was first used for grazing in the savannas or woodland pastures, later for the growing of cotton, sugar cane, and corn, and more recently for citrus fruits. Since the end of the last century it has produced turpentine, lumber, and phosphate. Most of these industries survive, having undergone many fluctuations, especially in certain localities, as indicated in the following descriptions. Three small areas, Lecanto, Blanton, and Citra will be described in detail to illustrate the development of farm types under varying natural conditions.

LECANTO

In the high rolling pine land near the center of Citrus County lies Lecanto, perhaps the earliest inland settlement in the county. The nucleus was a small pond, a stopping place for wagon trains en route from Ocala to Brooksville and beyond, and, on account of this condi-

FIGURE 1.—West-central Florida, showing the location of the type studies and the areas to which they belong.

* This study was aided by a grant from the Rockefeller Foundation through the University of Minnesota.

tion, the early settlement was called "Middle Ground." The pond provided water in a region where, in spite of 50 inches of rainfall annually, surface water is very scarce. Everywhere the rolling hilly surface is covered with medium white sand; 2 feet beneath the surface the sand includes some clay, at 5 feet sandy clay is usually found, the concentration of clay increasing to bed rock, which is usually 20 feet or more beneath the surface. A well drilled southeast of the crossroads at Lecanto logged 4 feet of sand and 31 feet of sandy clay to bed rock. Four miles west of Lecanto a quarry of the Crystal River Rock Company gives an excellent exposure of soil and bed rock (Figure 2), the Ocala limestone which underlies most of the Central Florida karst. The quarry is at the margin of the hilly pine land and the flatwoods to the west, at the site of a natural cliff. This cliff marks the inner boundary of the Pensacola terrace. (See *The Pensacola Terrace and Associated Beaches and Bars in Florida*, by Frank Leverett, published in the Florida Geological Survey Bulletin, No. 7, 1931.) At the top of the cliff there is an overburden of 3 feet of sand and 4 feet of clay, the contact of clay and rock being very irregular. The limestone varies in quality from hard crystalline limestone to soft porous crumbly material.

The settlers at Lecanto came largely from the Carolinas, and, as in their former homes, began to grow cotton, corn, vegetables, and raise cattle and hogs. Aside from the sporadic attempts at truck farming and the elimination of cotton (partly because of the boll weevil) the type of farming has changed little. With the stimulation of the citrus industry at the close of the last century, many of the farmers at Lecanto planted small seedling orange groves, for home consumption and in a few cases for sale. Following the "Big Freeze" in 1894–95, almost all the orange trees were killed and today scarcely a dozen live trees are to be found. That the farmers were not skilled in citrus culture, were not giving it their best attention, is indicated by the fact that the groves were "planted in between the

FIGURE 2.—A view of the rock quarry of the Crystal River Rock Co., about four miles west of Lecanto where the overburden of sand and clay is relatively thin.

hills to protect them from the frost." Nevertheless, the residents of Lecanto hoped that oranges would replace cotton as a money crop, the latter being then on the decline.

Today Lecanto is without oranges or cotton and the principal crops are corn and peanuts, sweet potatoes, truck crops, ground almonds (chufas), and various legumes intended to improve the soil. Corn and peanuts in alternate rows is the common practice (Figure 5). Corn is sometimes planted after the early truck crops have been harvested, but land is so plentiful and fertility is so low that two crops are seldom attempted in one year. Invariably the fodder is pulled from the stalk, leaving the ears to be harvested later. The blades (fodder) are tied into bundles to be used in lieu of hay, since the latter is not readily cured in this moist climate.

In spite of the cessation of cotton growing and the lack of a good money crop, the population of Lecanto has gradually increased, from 288 in 1900 to 319 (of which 35 are negroes) in 1930. There are fifty farms in the school district, most of them subsistence farms. The increase in population is probably to be explained by the Crystal River Rock quarry, the influx of land speculators and tourists. In general the size of the land holdings has decreased and about 40 per cent of the land has reverted to the state for taxes.

BLANTON

Blanton lies in the great Annutalaga Hammock which extends from the southern part of Citrus County through Hernando County to the south-central part of Pasco County (Figure 1). This is a hilly belt similar to the Lecanto Area, but here the hills take the form of level-topped ridges and mesas covered with pine, and deep solution depressions, the bottoms lying at about the same level and covered with hammock or occupied by lake or swamp. Near the center of this area lies the town of Blanton west of which six square miles were mapped, as is shown in Figure 6. The most important towns in this area are Dade City and Brooksville (Figure 1).

In the vicinity of Blanton the land may be described as a dissected plain, the highest parts lying at an elevation of about 200 feet above sea level, the bottom of the solution depressions, usually strung along a more or less definite valley, at about 100 feet above sea level. In most places the slope from the upland to the depressions is an abrupt one of ten degrees or slightly more, as at Moody and Jessamine lakes (Figure 6). Near Iola Lake and to the east of the upland the slope is in many cases more gentle. The broad features of the land are de-

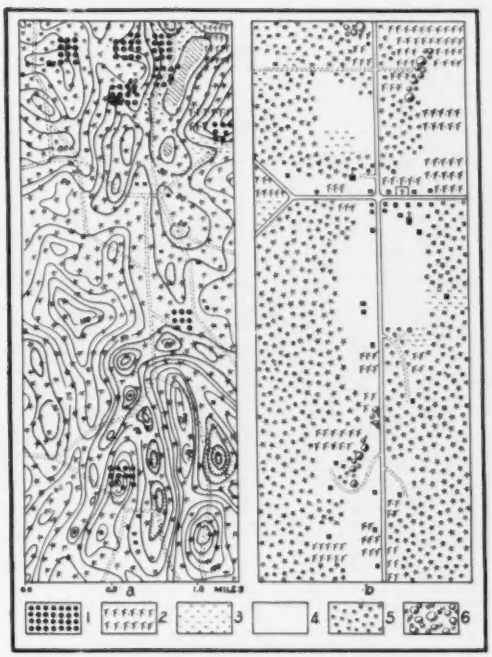

FIGURE 3.—Land utilization at Lecanto: a. in 1893 and b. in 1932. 1. Orange groves; 2. corn; 3. truck crops; 4. idle land (a part is used in winter); 5. pine; 6. hammock. The data for "a," as in the following maps, was obtained from local records.

FIGURE 4.—An abandoned field in the bottom of a depression near Lecanto. After continuous cultivation for fifteen years it is now producing oak, wild persimmon, and dog fennel. The original timber was long leaf pine.

termined by the stream dissection and the solution accompanying it.

Throughout the area, except on the swampy margins of the receding lakes, the top soil is sand with a very small amount of humus. The thickness of the sand and underlying clay is extremely variable as may be readily seen in the numerous clay pits, road, and railroad cuts. The clay is used on the sand roads to make them more compact.

On the uplands and on the upper slopes, the natural vegetation is the long leaf pine and associated forms. Near Blanton the pine woods were open at the time of settlement, there was little undergrowth and a wagon could be driven readily to almost any point on the upland. The presence of a mat of pine needles on the forest floor aided transportation by preventing the vehicles from sinking into the sand. Such land was easily cleared, was in fact cleared in some cases by fires of natural and cultural origin. When an area was cleared and then allowed to revert to pine woods a somewhat different vegetation resulted. In many places the pine was partially replaced with turkey oak and black oak, trees which rarely reached large size in the pine land but formed, for a time at least, a denser stand than the original pine. So the cut-over or burned-over land, including most of this region near Blanton, is in fact today a mixture of oak and pine, though still referred to as pine land.

In the hammocks a great many varieties of trees are growing, relatively little disturbed by fire or ax. Fringing the lakes or occupying the low solution depressions not too wet, the site is protected from fire by its position and moisture, and from the ax by the density and variety of the stand. The lumberman prefers the uniform pine forest to the mixed hardwoods of the hammock: the live oak, the water oak, the red gum, the tupelo gum, the red bay, ash, elm, and magnolia, for most of which there is little demand. Then, too, the hammocks are usually small, unfavorable for large scale lumbering operations. So the hammocks in the Blanton Area are only partially cleared, in spite of the fact that they occupy the best soil in the region.

Most of the settlement in this district was around the margin of the upland (Figure 6a), neither in the highest nor lowest locations. This assured best air drainage, thinnest sand with clay closest to the surface and water supply. Also the lake shores were shunned because of insects, particularly small gnats, and because of the swampy land.

Upon these isolated farms the settlers

FIGURE 5.—A field of corn and peanuts with white sand showing between the rows. Fodder has been "pulled" so that only the stalks and ears of the corn remain.

raised corn, cotton, sugar cane, and a variety of subsistence crops, their cattle ran wild through the woods; a few individuals even specialized in cattle. Lumbering was important until recently, the remains of the mill sites are yet to be seen. Now, however, most of the commercial pine has been cut over and a few large mills take the place of the small portable outfits, the cut now in this vicinity being mostly hardwood.

The orange trees which have been the primary interest of the community were not obtained from the neighborhood hammocks though the wild orange tree grew there, but seeds and nursery stock were obtained from other groves, particularly Homasassa. At the time of the "Big Freeze" the groves were seedling groves; in the vicinity of Blanton there were a dozen or more groves (Figure 6a) averaging about five acres. At that

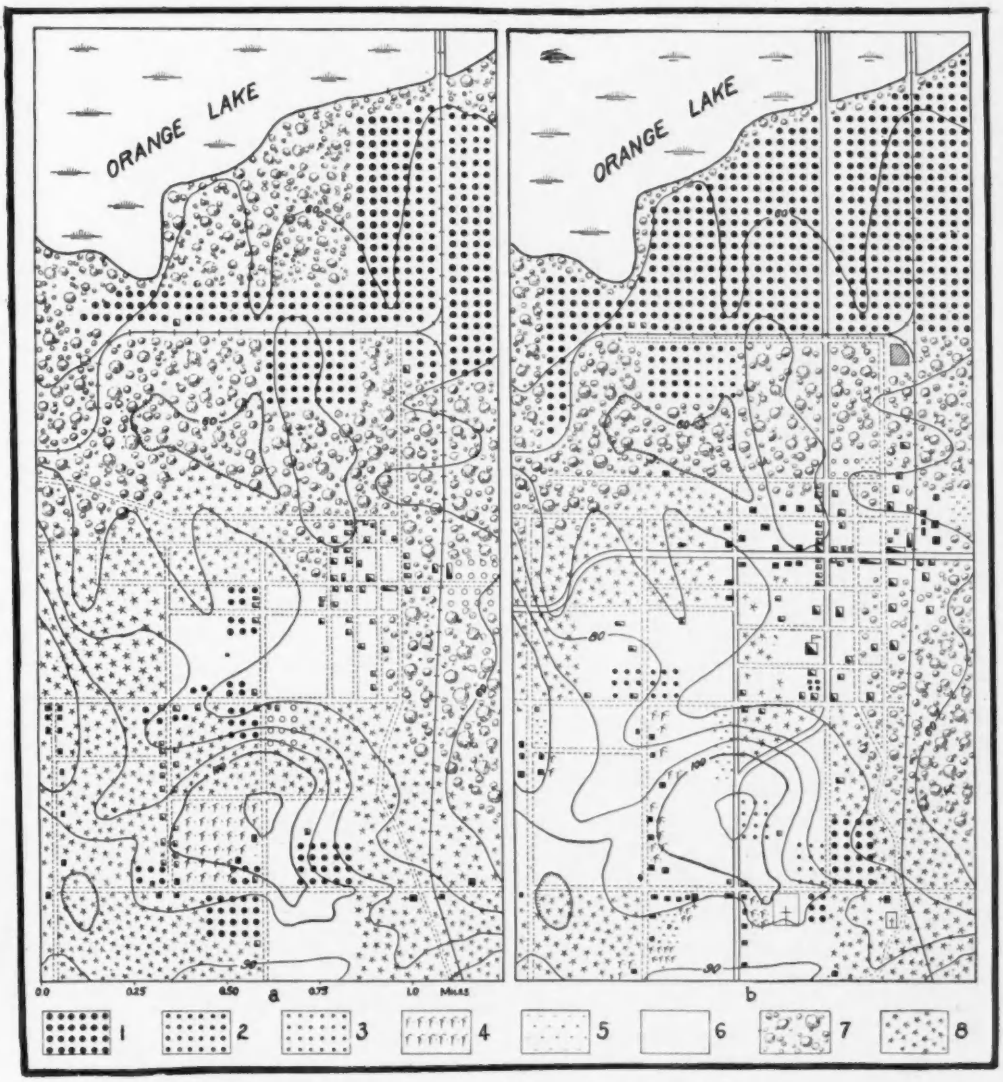

FIGURE 6.—A farming area near Blanton in a. 1893 and b. 1932. 1. Orange grove; 2. abandoned grove; 3. truck crops; 4. idle land; 5. hammock; 6. pine. These maps show the great increase in orange since the "Big Freeze" of 1894–95.

time 56 persons held land in six sections, an average of nearly 70 acres per farm. The largest holding was 320 acres, the smallest 10 acres. As in the adjacent areas all the groves were destroyed by the "Big Freeze" and for a time the farmers turned to other crops, but many of them immediately began to develop new groves, so that by the turn of the century oranges had become the chief money crop.

FIGURE 7.—Part of an abandoned grove on the pine land about one mile south of Citra. On the right the orange trees which have been injured by frost are being choked by Spanish moss.

CITRA

On the south shore of Orange Lake lies the dual community of Citra; the nucleus in the edge of the hammock which borders the lake, and an outlying portion on the pine land more than a mile from the lake (Figure 8). To the east and west are low swampy savannas, to the north the elongated intermittent eastern end of Orange Lake, to the south the gently undulating pine land. In the hammock near the present town lived the Indians in pre-settlement days as attested by mounds, one of which may be seen near the Seaboard Airline railway about one mile north of Citra Station. The presence of Indians is also mentioned by the early travelers. William Bartram speaks of them in his *The Travels of William Bartram*, published in Philadelphia in 1791, and reprinted in 1928 by Macy-Masius. The Indians found here a variety of resources; the lake furnished fish and fowl, the hammocks venison and bear meat, the savannas pastures for their cattle (obtained from the Spaniards) and arable land for their crops. Around the villages grew small plots of corn, beans, and tobacco, in the nearby savannas sweet potato, several varieties of pumpkins, squash, melons, beans, and corn. The casual excursions of these sedentary Indians after they had obtained the sour Seville orange from the Spaniards led to the establishment of the wild orange groves in many parts of Central Florida more than a century and a half ago. Bartram observed wild groves in many places some of which it is impossible to locate today and almost invariably he noted at the same points evidence of Indian settlement. There is little doubt that the Indians obtained the sour orange from the Spaniards, distributed the seed to favorable locations on the banks of the rivers and the shores of the lakes, whence the wild groves, the nucleus of Florida's citrus industry, sprang.

In 1870 the most extensive wild groves were on the shores of Orange, Griffin, Harris, Weir, Panasoffke, Jessup, George, and Apopka lakes and along the Oklawaha, Withlacoochee, and St. Johns rivers. (See A. J. Harris's *The Wild Orange Groves of Florida. In Lanier, Sidney, "Florida."* Philadelphia, 1876, pp. 276–281.) Today few wild groves remain; a small one about one mile northeast of Citra shows the remarkable contrast in appearance with the cultivated grove. Growing in the shadow of the hammock the slender branchless trunks rise 20 feet or more from the ground, striving upward toward the light. The branches spread out in an inverted cone rather than the spheroidal crown of the cultivated tree.

When the attention of the people turned to citrus, the feasibility of con-

verting the wild groves was quickly realized. The wild trees were chopped off 3 or 4 feet above the ground, the underbrush and small timber cleared, and many of the orange trees removed, all of the brush and timber decaying in a few years. A month later the trees were budded or grafted. In two years' time, usually, a few sweet oranges were obtained in contrast with eight years from seedlings or nursery stock. More than twenty years later before the "Big Freeze" most of the extensive groves were north of the 28th parallel, corresponding to the distribution of the wild groves.

Concentrated in the hammock belt near Citra in 1893 were about 700 acres of grove land, of which 400 acres were improved, probably 200 acres in bearing groves. At the same time to the south of Citra on the pine land there was less than 100 acres in grove. The contrast between the two sites, in view of the ultimate success of the groves in the hammocks and the almost complete failure in the pine land, merits careful attention. Normally the advantage of slope is in favor of the pine land; most of the groves were located on gentle northern slopes, well drained, easily cultivated. In the hammocks the land was flat, offering no advantage of air drainage. The soils of the two sites are in strong contrast, since the upland soils are entirely sand on the surface, underlain by a sandy clay at a depth of several feet. A well drilled in one of the small groves remaining on the pine land logged 8 feet of sand, 19 feet of sandy clay, 48 feet from surface to solid bed rock. In the hammock at few points is there more than 2 or 3 feet of sand lying on the bed rock. Fragments of limestone are frequently picked up on the groves (Figure 9) and the removal of stumps in clearing the hammock land reveals rock in many places. In view of the amount of fertilizer used in the hammock groves, the question of soil fertility can scarcely be called critical, though the hammock soils are superior. The hammocks have a distinct advantage in the availability of lake water for irrigation but that has been used only recently, and in emergencies. The deciding factor was probably the occurrence of wild orange groves in the hammocks.

The most significant contrast between the two sites lay in the size of the groves and the greater resources of the large grove owners. All alike were devastated by the two successive freezes of December 1894, and February 1895, but the large growers were in the business to stay and immediately set to work to re-

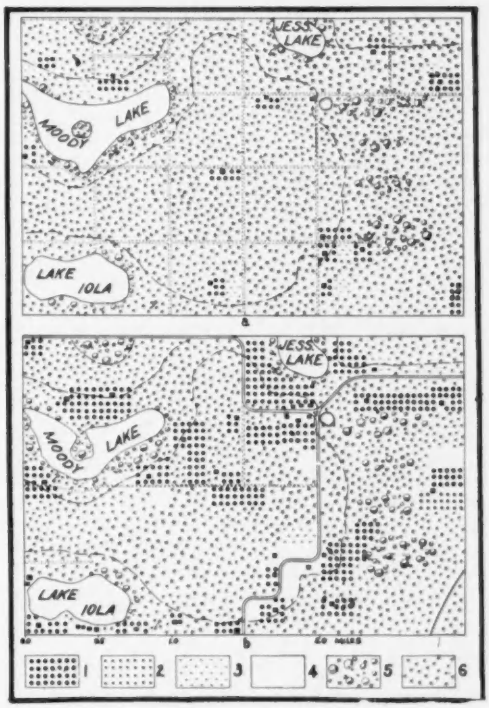

FIGURE 8.—Citra and vicinity in a. 1893 and b. 1932. 1. Bearing citrus groves, mostly oranges; 2. young groves; 3. abandoned groves; 4. corn and peanuts; 5. truck crops; 6. idle land; 7. hammock; 8. pine. Although more intensive citrus production for large areas is to be found south of the region here described, there has been a large increase in acreage of citrus fruits since the groves were destroyed by the "Big Freeze." The solid black squares represent negro residences.

habilitate their groves. Some of the smaller grove owners moved away, others turned to other lines of endeavor so that while the larger groves were being brought back to the bearing stage, the smaller were in many cases abandoned. This marked the beginning of a trend which is still in progress, the gradual elimination of the small grove owner. Those remaining today in Central Florida are dependent on the larger growers to pick, grade, and market their crop.

Today the citrus industry of Citra is in excess of that before the freeze. Many of the small groves were abandoned, none of the large ones. In the hammocks are the large groves, 100 to 350 acres in size, with improved packing houses, carefully administered, using lake water and well water for irrigation, and fertilizer in large quantities. Nearly all of the hammock land suitable for citrus has been cleared. In the summer of 1932 most of the few remaining patches were being cleared at great expense. Some of the hammock land is so low as to make it liable to flooding at high stages of Orange Lake. In such places each young orange tree is placed on a small mound constructed for the purpose.

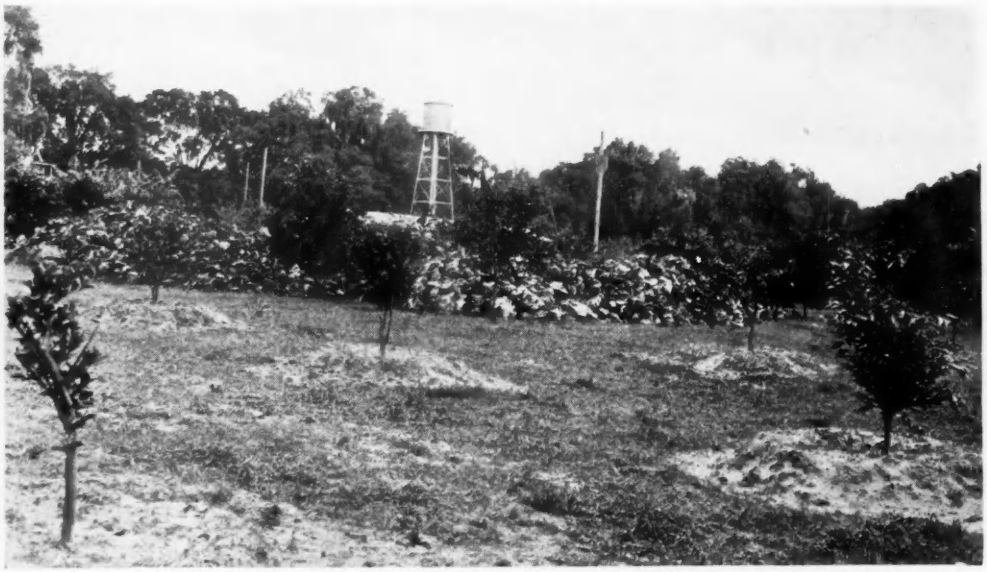

FIGURE 9.—A young orange grove in Citra with moss covered live and water oaks in the background. The pile of limestone fragments in the middle distance is good evidence of the thinness of the soil in the hammocks.

SUMMARY OF FARM TYPES

The three type studies above are intended to show the range of natural and cultural landscape in west-central Florida especially the salient points in the agricultural development of the country. Three types of surface have been noted from the earliest times: the rolling "high pine land," the low hammocks bordering the lakes and rivers, and the great Annutalaga Hammock. More detailed descriptions of the soils and vegetation may be found in the various reports of the Florida Geological Survey (see especially E. H. Sellards, and others, *The Natural Resources of Central Florida.* Florida Geological Survey, 7th Annual Report, 1915. And R. M. Harper, *Geography of Central Florida.* Florida

Geological Survey 13th Annual Report, 1919–1920), but it is not at all apparent that a close correlation exists between minute natural and cultural subdivisions.

Various factors have combined to produce the farm types of central Florida, through modification of the "general" farming system brought in by the settlers, in which corn, cotton, sugar cane, peanuts, and indigo were important crops. Gradually all except the corn and peanuts have been eliminated or reduced in importance and in their places have appeared the citrus fruits and vegetables, in varying proportion in different parts of the country.

As a result of the physical and cultural factors enumerated above two features stand out: the segregation of most of the farms into relatively small neighborhoods, leaving a large part of the land unoccupied, and secondly, the general similarity of farm type, except for varying relative acreage of vegetables and orchard fruits. The first feature is quite striking to the traveler, and in addition is suggested by the low percentage of land in farms, ranging from 6.1 per cent in Citrus County to 19.4 per cent in Marion County. (Fifteenth Census of the United States. Agriculture V. 2, Pt. 2, 1932.) Characteristically the cultivated areas are near towns and villages and the intervening lands have few or no farms. In addition to the small percentage of land in farms, the proportion of cropped land is low (Figure 10).

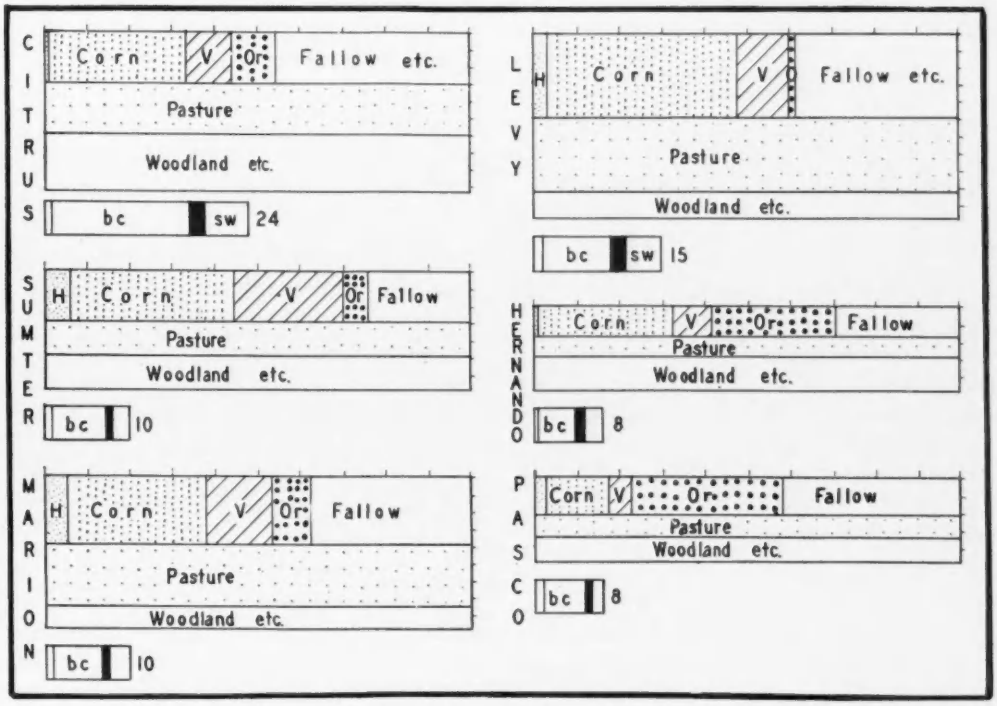

FIGURE 10.—The graphs are designed to show at a glance the salient agricultural features of the six counties of west central Florida. Average farms are indicated in their true proportions and acreage may be read from the ten-acre divisions on the vertical margins. Crop percentages are marked on the top lines in 10 percent divisions. Thus the average farm in Citrus County is 93 acres, of which 30 acres are cropped and 30 pasture. Percentages of hay (H), corn, vegetables (V), orchard (or), and fallow are shown according to the acreage. The livestock bar graph gives the relative numbers of horses, beef cattle (bc), dairy cattle (solid black), and swine (sw), the last reduced to units in the proportion of 5 swine to one cow or horse. Total livestock units per farm are indicated by number.

Most of the remaining farm land is in woodland and pasture, the latter including a large amount of woodland pasture with rather poor grazing value. Of the cropped land corn has the largest acreage, but it is mostly a subsistence crop and the value is comparatively small. Most of the peanuts are grown with the corn, and have little acreage to themselves. The varying acreage of orchard fruits and vegetables is the most definitive feature of the farms. In general the northern counties of this district have more land in vegetables, principally string beans, watermelon, and tomatoes (for a discussion of vegetables in Florida see *Where Florida Truck Crops Are Grown*, by John L. Wann, published in ECONOMIC GEOGRAPHY, Vol. 9, No. 1, Jan. 1933), the southern counties (Sumter excepted) more in orchard, of which about three-fourths is citrus. Also the cropped land per farm is smaller to the south (Figure 10).

In view of the large proportion of pasture land livestock is not important, "woods cattle" and swine making up the largest proportion. Dairying is not important, the average farm having less than two milk cows. The difficulty of curing hay, the scarcity of good forage grasses, and the presence of ticks in some areas have been potent factors in the limitation of livestock, especially purebred varieties.

Finally it may be said that the types of agriculture described above show evidence of instability in many particulars. Observations indicate, for example, that more hammock land is being cleared and put under cultivation, partly as a result of lumbering operations in the hardwoods and partly because the farmers are appreciating the greater fertility of the hammock soils. Undoubtedly some of the high pine land is being abandoned in certain localities, for example, in the Lecanto district. Since the cultivation of early vegetables or citrus fruits requires large amounts of commercial fertilizer (unfortunately the local phosphate is not "available" in the crude form), the market must be good to stimulate production. Thus the future of this region depends to a large extent on external factors.

THE CHEWING GUM INDUSTRY

Charles Landon

WHILE the manufacture of chewing gum is only a minor industry, yet it is a product with which practically every American and millions of people in foreign countries are familiar. Regarded originally as a typical American habit, and one on which foreigners frowned, its use has spread until today it is found in all of the important markets of the world. The marked increase in its use in foreign countries has been since 1914. In Europe this increase was brought about by the American soldier. He used it for its quieting effect, its aid to digestion, and for quenching his thirst when good water was unattainable. Soldiers of other countries adopted the habit, and on their returning home became important influences in advertising the product. In other countries, especially those of the Orient, aggressive sales methods and the willingness on the part of manufacturers to cater and accede to the wishes of foreigners have also been important in expanding the market. Exports increased from less than $200,000 in 1914, to $1,547,000 in 1929.

During this same period, consumption in the United States increased from 39 sticks per person in 1914 to 109 sticks in 1929.

In 1929 there were 37 plants in the United States that were manufacturing chewing gum. This is a decline from 74 in 1914. These 37 plants employed 2,265 workers whereas those of 1914 employed 2,048. The value of the product produced in 1929 was $60,160,-126 while the value of the raw material used was $23,231,172. Corresponding figures for 1914 were $17,159,607 and $7,322,299 respectively. The retail value of approximately 60 million dollars of production in 1929 was about $114,000,000.

The decline in the number of plants during this boom period of the industry is due largely to the fact that the cost of advertising is prohibitive to the small concern. Some small producers still exist in the industry, but the small factory fared badly during this period of expansion in the industry. Other influences are the cost of machinery and the difficulty in obtaining a supply of chicle. The concern with a small capital is at a disadvantage in both respects, since, in the modern factory, the product is largely machine made, and, to insure a supply of chicle, a concession must be obtained from some Latin American government. Some chicle is sold by brokers and native gatherers, but a manufacturer cannot depend upon these market channels for a sufficient supply.

The prestige of the better entrenched manufacturers in the industry is also difficult to overcome. Some concerns, well established in their own field, recently attempted to put new brands of chewing gum on the market, but after a while they had to abandon their attempts and take the chewing gum from the market because it would not sell.

The development of the industry dates back to a night in 1866 when one Thomas A. Adams, Jr., visited General Sareta Anna, then a candidate for the Presidency of Mexico, at Snug Harbor on Staten Island. The general gave Mr. Adams a piece of dark colored gum (chicle) to chew, and when the visit was over Mr. Adams asked for a larger piece

to take home with him to see if it could be vulcanized, his intention being to use it as a base for false teeth. His experiment was unsuccessful and he decided that its only use was to be chewed. Whereupon, he rolled it out with his wife's rolling pin and sent it to a confectionery store in Jersey City, where it was an immediate sensation. It was at first given away with candy in order to acquaint the public with the product. The early chewing gums had no other ingredients than the chicle, but experimentation showed that the chicle compounded readily with the other ingredients that now enter into the manufacture of chewing gum. When these were added, its sale was more successful than at first.

Mr. Adams and his father started the first chewing gum factory on a capital of $35. The product was at first made by hand, but in 1871, the elder Mr. Adams made the first chewing gum machine. This factory existed until 1899 when, with other plants, it was merged into the present American Chicle Company.

Previous to this time, a variety of other gums had been chewed, most of them being the natural gums that exude from different species of trees. One of the most popular was black spruce gum. It gave an aromatic chew but was bitter and became harder and more brittle as it was chewed. Hunters used it to quench their thirst. It was sold in bulk in the stores of the period when it was used. Other gums used were those from the sweet gum, cherry, and tamarack trees, paraffin, and beeswax. Some of these are still used occasionally by curious and enterprising young boys. Neither should "slippery" elm be forgotten in this connection, although it is the inner bark rather than the gum of a tree.

In the Orient a number of natural gums are chewed by the natives, and some of them are gathered and used as ingredients of chewing gum.

SOURCES OF CHICLE

Chicle is the yellowish-white, partially evaporated, sticky juice of the naseberry

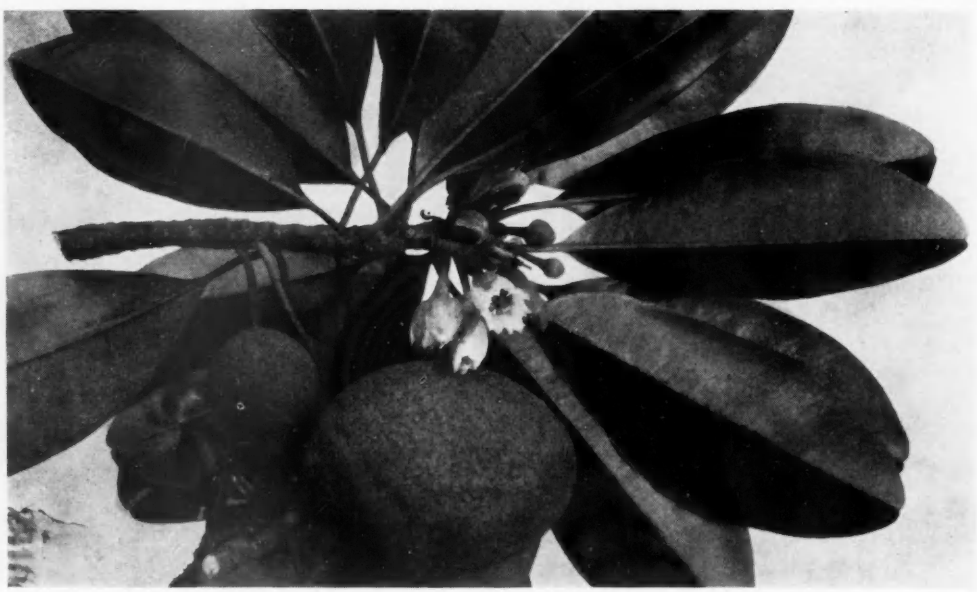

FIGURE 1.—The fruit and flowers of the sapodilla from which the latex comes that produces chicle. The tree is a dark green lustrous, dense mass of thick leaves. (Courtesy of U. S. Dept. of Agriculture.)

tree, *Achras sapota,* an evergreen tree with thick, glossy leaves, that is native to the countries of the Caribbean region. Similar trees are found in the Amazon valley, in Hawaii and the Philippines, and in other parts of the tropics. The tree, which is adapted to warm, damp conditions, and which seems to grow best in such regions in Mexico, attains a height of 40 to 50, and often 75 feet and a diameter of about 40 inches when mature, which is at the age of about 50 years. A mature tree will produce about five pounds of chicle annually.

This tree also has a fruit called the sapodilla, which looks like a small russet apple and tastes somewhat like a pear sweetened with brown sugar. The hard, red wood of the tree is used sometimes for making furniture and for construction purposes.

The best quality of chicle, and also the greatest quantity, comes from Mexico in the region between Tuxpam and southern Yucatan. This is in the limestone region of Yucatan, and the exploitation of the chicle forests has resulted in many Mayan discoveries. Here the industry is largely in the hands of interests from the United States which own a belt of lands from 75 to 100 miles in width and 120 to 150 miles in length. The three leaders of the chewing gum industry gather most of their own requirements, the Wrigley Company through its own company, and the Beechnut Packing Company and the American Chicle Company jointly through a subsidiary, the Chicle Development Company. These companies buy small amounts from brokers and native producers. In some of the towns of this region of Mexico, the chicle industry supports a majority of the people.

Guatemala, in the Department of Petén, bordering on Mexico and British Honduras, is said to have enormous supplies of excellent chicle. Some trees, it is claimed, yield 100 pounds per year. Distance and other influences, however, handicap the region. Almost all of the chicle land is owned by the government, which issues a permit for the collection of the product. The price of the land ranges from $45 to $60 per acre, but the owners of the concessions have no other rights in the land after the chicle has been removed. Transportation costs from this region to Belize, the chief point of export, are high. At Flores, the chief assembling point, it is worth from $16 to $20 per quintal in United States gold. From there it goes by mule back to El Cayo, then down the Belize River to Belize. When it reaches the seaport it is worth from $33 to $40 or more per quintal, due to the transportation cost.

The following table shows the recent cost per hundred pounds in United States money of chicle from Petén placed in Belize for export.

Extraction permit and municipal taxes	$ 2.80
To chiclero	10.00
From concentration ground to Lake Itza	10.00
Transportation on Lake Itza	.50
From Lake Itza to Cayo, British Honduras	10.00
Cayo to Belize	1.50
Export duty (.07 per lb.)	7.00
Transit tolls through British Honduras	1.50
Wrapping materials	.50
	$43.80

Ocean transportation costs from Belize to New Orleans or New York are usually about one dollar per hundred pounds.

Ranking next to Guatemala is British Honduras, where chicle production has recently assumed the importance of a leading industry. It leads in value of exports and as a source of revenue to the government through export duties. The best chicle from this country compares favorably in quality with that from Mexico but a number of inferior varieties are taken from various kinds of trees and used as an adulterant with better qualities of chicle. The greater

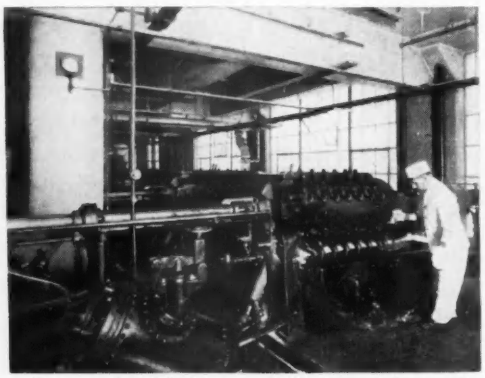

FIGURE 2.—Highly specialized machinery, designed for the particular purpose, is utilized in the processing of chicle for chewing gum. (Courtesy of American Chicle Co.)

part of the chicle exported from British Honduras has its origin in Mexico and Guatemala. In 1930, only 9 per cent of the exports were produced within the bounds of the colony.

About 1915, Colombia and Venezuela became important producers of chicle because of disturbed political conditions in Mexico, but recently their production has declined, the decline being most marked in Colombia where labor difficulties and high costs of production have been a hindrance. The Colombian chicle is also inferior to the Mexican. It has 83.2 per cent of resin and 5.5 per cent gutta in the wet material, while Mexican chicle has 44.8 per cent and 17.2 per cent respectively. If Colombian chicle is used for gum it must be mixed with better grades. The greater amount of gutta in chicle increases the elasticity of the gum made from it, this in turn adding to the enjoyment of the consumer.

It was thought for a time that Venezuelan chicle would be as good in quality as the Mexican, and cheaper, but this has not been the case. It is superior to the Colombian, and easier to obtain, which offers some inducement for its production.

Of the 1930 imports of about 14,000,000 pounds into the United States, Mexico contributed about 77 per cent and Guatemala about 22 per cent. The remaining supply came from scattered places, but chiefly from British Honduras.

Conservation of the trees is an important consideration if future requirements for chicle are to be met. At present, ruthless tapping and carelessness and ignorance cause the loss of many trees being estimated at 25 per cent by some of those familiar with the industry. More replanting and better methods of cultivating and tapping will aid a great deal. In British Honduras attempts at improvement have been made by cutting out the vines and other trees. It is claimed that plantation methods are not applicable on any scale until better methods of tapping have been worked out. Fear of a shortage of chicle has caused one American company to acquire 355,000 acres of land and introduce plantation methods. Not much chicle will be obtained from plantations for many years yet because of the long time required for a tree to reach a bearing age. In addition, plantation methods have only recently been introduced.

THE PRODUCTION OF CHICLE

The production or gathering of chicle represents the hunting or collection stage of industry. The chiclero, as the chicle hunter is called, simply takes a machete, a rope, iron spurs, and a canvas bag 12 inches by 6 inches in dimensions—the only equipment needed except food supplies—and goes into the forest to hunt the chicle trees and remove their sap. He must go during the rainy season which lasts from June until December, because the trees never yield at any other time. When the chiclero finds a tree, he starts an incision with his machete in the bark and cambium at the bottom and places the canvas bag, which is held in

place by two small sticks, under it to catch the sap. This incision is continued spirally around the tree until the branches are reached. Often a second incision is started opposite the first. This makes two intersecting grooves winding around the tree. These cuts are sometimes refreshed to increase the flow of the sap. Some hunters continue the incisions along the branches. This practice is forbidden in Petén. When the incision becomes too high for the chiclero to cut while standing on the ground, he puts on his spurs and wraps the rope around the tree and around his waist and continues up the tree much as a man climbing a telephone pole. The tapping of the trees is done in the early morning and the latex collected in the evening. A tree is tapped once every five years, requiring that period to recover from one tapping, and even then many of them are killed.

As the sap runs down the grooves it is slightly oxidized. It is collected in the evening and carried to a central point where, in some places, it is spread out and permitted to oxidize still further. Then it is put into a kettle, or sometimes an oven, with an equal amount of water and boiled slowly over a wood fire to drive off the excess moisture, being stirred constantly with a wooden paddle. When a certain thickness has been reached, the sap is poured into wooden molds. The resulting blocks, weighing about 25 pounds each, are wrapped in coarse canvas for exporting. In some places, the chicle is melted after being boiled down and certain flavors and colors are added. Then the doughy mass is kneaded into blocks, several of these being assembled into a bundle and wrapped for shipping. The boiling is usually done on Sunday, but no one seems to know the reason for this. The chiclero works under a contract which calls for the delivery of the blocks of chicle at a concentrating point where the contractor takes charge. He is paid at the rate of about $10 in United States money per hundred pounds, less a discount which depends upon the degree of moisture. As much as 35 per cent moisture is permitted.

These contracts are made by both exporters and private merchants, at Belize, the chief exporting point, the latter usually offering the more liberal terms. The contracts are authorized by municipal authorities and the terms are not easy. The chiclero agrees to deliver a certain amount of chicle at the end of the season. He usually underrates his capacity in order that he will be able to deliver the amount required and in order that, this being unknown to the contractor, he may have extra time to produce chicle to get extra money to exchange for various articles of merchandise dictated by his fancy.

The exporter or private merchant advances money to the contractor in the form of I. O. U.'s at the beginning of the season. These are discounted by the contractor among the smaller merchants; and he in turn loans small amounts to the chicleros for supplies which are purchased in the shops of many of the homes in the small towns and villages.

FIGURE 3.—The interior of a chicle processing plant where chewing gum is made. (Courtesy of American Chicle Co.)

The preceding description tells how the small-scale, independent gatherer works: On the lands controlled by the large companies in the United States, the chicle is taken and prepared in the same manner, but the work is organized differently. There is more teamwork and specialization. For instance, one group cuts the incisions while another collects the sap and carries it to the place for boiling. Also, the individual traders and merchants would not be found in the organizations of these large companies.

LOCATION OF CHEWING GUM INDUSTRY

Chewing gum is made chiefly by concerns which have it as their chief product. About 2 per cent of the total production is made in factories which manufacture it as a secondary product. About 5 per cent of the production of factories which make it as their chief product is of other products than chewing gum. Three types of chewing gum are made. The most important one is the regular stick type of gum. The others are ball chewing gum and chewing gum novelties. Some factories make all three types.

Most of the world's chewing gum is made in the United States, and three companies manufacture practically the entire supply. The Wm. Wrigley Company leads with 60 per cent of the total production. The Beechnut Packing Company is second with 20 per cent and the American Chicle Company third with 15 per cent. Plants in the United States also have branch factories in foreign countries, the majority of them being in the United Kingdom. The Wm. Wrigley Company has factories in Canada, England, Germany, and Australia.

Other countries, chiefly Mexico and Canada, manufacture small quantities. There is also a small household manufacturing industry in some countries notably Japan, Germany, and Egypt.

While the factories are widely scattered in the United States, the majority of them are near the seaports of the Middle Atlantic States. The one with the greatest production, however, is in Chicago. The location of many of the factories in or near seaports is likely caused by the fact that many of the ingredients are imported. Good markets also exist in these places.

Of the present total of twenty-four factories, New York leads all of the states with eight. Long Island has four of these, two being in Brooklyn and two in Long Island City. The American Chicle Company is in the latter place. The Beechnut factory is at Canajoharie. Rochester, Buffalo, and New York City each have one factory.

Pennsylvania ranks second among the states with three factories, two being in Philadelphia and one in Pittsburgh. Massachusetts has one plant in Allston and one in Boston. In Ohio, Shelby and Dayton each have one plant. Baltimore and Chicago each have two factories, as does Wisconsin, one being in Milwaukee and the other in Eau Claire. Kansas City, Missouri; Provo, Utah; and San Francisco each have one factory.

An early start and accidental influences are probably very important in the location of chewing gum factories and manufacturing centers.

THE PROCESSES OF MANUFACTURE

The manufacture of chewing gum is marked by the extensive use of complex and expensive machines. The use of handling equipment and of gravity conveyors is important. Six steps or stages may be noted: 1. the grinding and melting of the chicle; 2. the mixing of the ingredients into the melted mass and

the churning and kneading of this mass; 3. the rolling of the mass into thin sheets which are cut up into sticks of gum; 4. wrapping the gum; 5. packing and boxing the wrapped sticks; and 6. carrying to the conditioning and stock rooms from where it is shipped.

First, the chicle is brought from the store room on trucks, to the machines where it is ground and melted to a viscous mass. This mass then flows through pipes into enormous steam-jacketed mixing machines, which are like cement mixers and where a temperature of 250° F. is maintained. A large factory has line after line of these machines. Each one holds enough material for 150,000 sticks of gum. In this machine, the other ingredients are added gradually in the precise amounts, being weighed automatically. After the other products are added, these machines continue to churn and knead the mass with giant paddles until it is of uniform texture.

Next, this blended product is fed into an automatic machine where a series of rollers roll it into thin sheets about one foot square. Then knives score these sheets into small rectangles the size of a stick of chewing gum. Powdered sugar is sprinkled on the gum to prevent its sticking to the machinery. These sheets of gum are then piled on trays by a special handling device. The trays are stored until the gum is ready to be wrapped.

A wrapping machine has a capacity of 300,000 sticks of gum per day and requires two girls to operate it, one to feed it and the other to guide the boxing. This machine picks up each stick of gum and encloses it first in a wrapper, then in a label. It then gathers five sticks together and seals them in an air-tight package and completes its work by covering the package with a label.

From here, moving belts carry the packages through a series of boxing and packing operations. First, they are packed in cartons, the cartons being delivered to the inspection department on trucks holding 1,100 cartons each. Inspection consists of opening boxes to see if the wrappers are intact and the proper quantity is contained. When ten cartons are inspected, they are placed on a belt conveyor which takes them to a machine where each is sealed with a band.

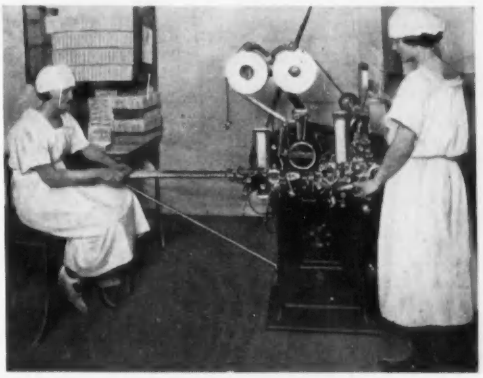

FIGURE 4.—The labor employed in the manufacturing plants where chewing gum is made must maintain high standards of cleanliness as well as mechanical skill. (Courtesy of American Chicle Co.)

They then go to another department where 100 cartons are placed in shipping cases of 125 pounds each, and are sealed by the case sealer. The boxes are nailed shut and bound with wire, and then checked and inspected and sent to the shipping department. When they are shipped, they are carried to a car or a truck by a conveyor, and each box is numbered consecutively by a hand-numbering machine.

Throughout the entire manufacturing process, it is necessary to keep the temperature and humidity of the factory within certain limits because chewing gum is especially susceptible to these two influences. This is accomplished by automatic means. If the temperature drops too low, the gum becomes brittle; if it rises too high, the gum

becomes sticky and difficult to handle.

In manufacture, the mixing of the several ingredients is important, it being necessary that they be added gradually in a fixed order to the melted gum in exactly the correct amounts with the temperature of the mass at about 250° F. Thirteen pounds of chicle as it comes from the final processing will make about 5,000 sticks of chewing gum. A pound of chewing gum is 147 sticks.

A standard formula consists of : chicle 14%, chicle substitute 14%, caramel paste 1%, glucose 14%, powdered sugar 57%, and flavoring to suit the taste. On the average, sugar comprises about one-half of the total content in weight.

One of the important chicle substitutes is jelutong, from British Malaya. It is chewed a great deal in its native state by the East Indian natives. In 1930, the import of this gum was almost as great as that of chicle. It is not satisfactory when used alone, but compounds well with chicle. Recently, some of the important manufacturers have begun to use more of the substitute and less of the chicle, claiming that a better product is the result. Another group claims that better chewing gum is obtained when a high percentage of chicle is used.

Paraffin is another substitute which is used in the manufacture of cheap chewing gums. Such a gum crumbles when chewed.

The most popular flavoring extracts are peppermint and spearmint. About one-half of the chewing gum made has peppermint flavor. The United States supply of these comes from the west coast and from a small area in the vicinity of South Bend, Indiana. One farm of 3,000 acres sells its entire output of spearmint oil to the Wrigley Company.

Another flavoring is wintergreen or teaberry which grows in the mountains of North Carolina. There is also a synthetic wintergreen, while most fruit flavorings are synthetic. Licorice, which is used in some chewing gums, comes mainly from Turkey. Balsam of tolu from Colombia is also used in some formulas. It is collected much the same as is rubber. The antiseptic chewing gums have thymol added to them.

The following table shows the quantity and value of the various products going into chewing gum in 1929 :[1]

Sugar	60,707,949 lbs.	$3,089,565
Corn syrup	17,229,007 lbs.	609,213
Chicle	9,617,325 lbs.	6,720,039
Crude gums	10,686,006* lbs.	3,711,667
Essential oils		1,590,217
Flavoring extracts		285,623
Other materials		66,225

* Does not include 7,097,128 pounds valued at $95,791, used in factories making chewing gum as a secondary product.

FOREIGN TRADE

In 1929, the United Kingdom ranked first as an export market for American chewing gums followed by the Philippine Islands, Japan, China, and France, in the order named. Gum was sent however to almost all of the countries of the world. Gum wrappers are printed in 18 different languages.

Candy-coated gum is most popular in export markets because of its superior keeping qualities. This is an important consideration in hot, humid countries. Chewing gum is perishable even in dry storage. It becomes hard and crumbles in the mouth after about six months of storage. Shipments to the tropics are sent in glass jars, 100 packets to the jar. The candy coating also helps to sell the product where the habit of using it is not yet formed. Packets of six sticks each are also in demand in the export trade.

[1] U. S. Census.

GEOGRAPHY OF THE GLACIATED NORTH IDAHO PANHANDLE

J. Wright Baylor

THE glaciers were kind to northern Idaho. While it is true that the ice advances laid bare the underlying rocks in areas covering thousands of acres they left untouched the valuable minerals. They filled the valleys. They lessened the relief of the mountains. Moreover, their melting resulted in the formation of large areas of fertile outwash plains.

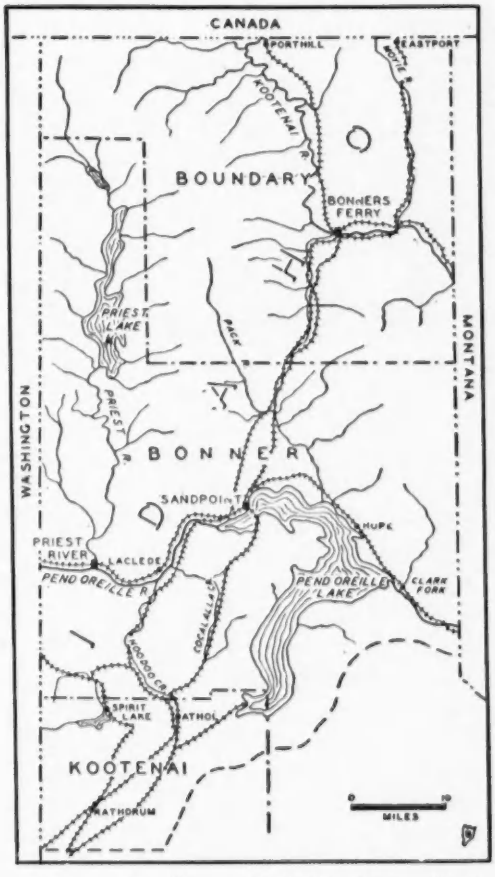

FIGURE 1.—The north Idaho Panhandle in which lie Priest Lake and Lake Pend Oreille is characterized by beautiful scenery, magnificent forests, abundance of fish and game, and other recreational advantages that rank high.

Were one to travel through certain ice-scoured districts he would probably fail to see wherein the country had benefited by the glacier's visit. Nevertheless, where there were relatively no level areas in Bonner and Boundary Counties previous to the ice advances we now find broad fertile valleys with sandy soils and meandering streams (Figure 2).

Because of the great importance of the famous Coeur d'Alene mining district and the recency of the agricultural development in the northern counties we may overlook the fact that there are now nearly a half million acres of land in farms. Also, we are apt to forget that two trans-continental railroads, several rail lines of lesser importance, and several main highways cross this area.

Our glaciated region is located immediately west of the Northern Bitter Roots and is on the eastern margin of the famous eastern Washington wheat belt (Figure 1).

The region is separated from the southern Panhandle agricultural sections, adjacent to Lewiston and Moscow, by the Coeur d'Alene mining district and a spur of the Coeur d'Alene Mountains extending westward across the Washington line south of Coeur d'Alene and the Spokane River.

CLIMATIC CHARACTERISTICS

A modified marine type of climate predominates throughout the region, but because of the following factors there are numerous minor variations of this climate type:

1. Air drainage into the valleys.
2. Presence of large lakes.

3. Great variation in elevations.
4. Protection by mountain ridges from north winds.

The elevation of the land is much more important than latitude as a temperature determinant. The presence of large lakes near at hand tends to lengthen the growing season in the vicinity of Sandpoint, Porthill, and Coeur d'Alene. While the growing season averages over one hundred days, even in the district north of the Pend Oreille River, frosts may occur on the higher bench lands or mountains during any month of the year. Were one to journey southward to the Spokane River he would cross areas experiencing the same unreliable growing seasons. However, while the frost free period may vary from 75 to 100 days, even there, one can usually be certain of at least four months without frost.

The region is characterized by the absence of excessive summer temperatures, the average for July for the lower elevations being but 65° while in the higher mountain valleys the mercury naturally remains much lower. Since there is low relative humidity during the summer months the nights are cool, making the climate very livable.

Winter temperatures of −20° are not uncommon, while −35° may occasionally be recorded. In spite of these more extreme temperatures, it must be remembered that the cold spells are of short duration, and not accompanied by wind. The northern blizzards, so common on the High Plains, are practically unknown, although there is a heavy snowfall in the area.

The rainfall of the different sections of the North Idaho Panhandle is as varied as the frost-free season. The least precipitation is found in the Spokane Valley, with the heaviest precipitation being in the Selkirk and Cabinet Ranges in the northern part. Priest River, located at the point where the south west winds start their ascent of the Selkirks, experiences ten inches more rainfall than Porthill, situated at some 700 feet lower elevation on the leeward side of the range. The average precipitation in the southwestern outwash sections is 18 to 20 inches, while the Pend Oreille Valley and the Purcell Trench Districts average 25 to 31 inches.

The major portion of the rain falls during the winter and spring. While this is characteristic of the west coast

FIGURE 2.—Looking down the Kootenai Valley. Note the broad fertile area hemmed in on either side by majestic timber clothed mountains.

climates there is sufficient summer precipitation here to aid materially in maintaining pasture and producing two or three crops of alfalfa. Since most of this precipitation of six to eight inches from April 1 to September 1, falls in April, May, and June, it is, also, especially valuable for the growth of spring wheat. It should be noted that the heavy snow blanket makes it possible to grow excellent crops of winter wheat without trouble (Figure 3).

FIGURE 3.—A typical winter scene in north Idaho. Three to six feet of snow is not uncommon even in the lowlands.

REGIONAL DIVISIONS

Hudson Bay fur trading posts were established near Laclede as early as 1864, as the region was easily accessible from the Spokane District or from the Kootenai Basin to the north. Before 1900 small clearings dotted the landscape, and several lumbering towns had started, the result of forest exploitation. While lumbering is still a major industry, it must now share its importance with agriculture. The third ranking industry is mining. Although there are several characteristic features of the region that are common to all districts there are at least five distinct divisions that may be recognized. Our regional treatment can well be done by recognizing the following regions:

1. Lower Kootenai Basin.
2. Pend Oreille Valley.
3. Priest Lake Basin.
4. Hoodoo-Cocalalla Glaciated Depression.
5. Rathdrum Outwash Plains.

LOWER KOOTENAI BASIN

The fertile Kootenai Valley is to the farmer in Boundary County what the oases are to the Arabs in the Sahara. Its thousands of acres of alluvial bottom or bench lands beckon to the agriculturist while the numerous mines in the flanking Selkirk and Cabinet Ranges signal to those interested in the exploitation of minerals.

In spite of the fact that the Kootenai flows in steep sided canyons much of its distance in British Columbia, Montana, and Idaho, it here meanders in a broad glaciated valley that is now filled with glacial outwash and stream laid alluvium. In addition to the broad alluvial flats of the Kootenai there are many small alluvial fans formed where the mountain streams issue forth from their narrow canyons and drop their load of sand and silt along the sides of the major depression. These streams, most of which have a fairly steep gradient, descend from the Selkirk Plateau which is

described by Anderson as "a highly dissected, glaciated plateau rising to 7,500 feet. The accordance of the summits is most striking, thus giving the appearance of a deeply dissected upland surface. Out of this rise peaks of greater elevation, while great trough-like valleys have been eroded into the plateau surface." This quotation well describes the entire mountain area north of the Pend Oreille River.

Soils.—The high fertility of the Kootenai Valley soils places them on a par, as to productivity, with any in the United States. In the river bottom lands the soils are of great depth, fine textured, and high in plant food constituents.

After a careful survey of the soils found in various parts of northern Idaho, Colver and Jones asserted that "The low lands require only protection against flood waters and drainage to insure high productivity from the start. When properly diked and drained they can be put under cultivation just as easily as open prairie lands. They are natural meadow lands rich in all the essential elements of plant food and will prove to be adapted to a wide range of truck or general farm crops. The bench and higher lands are rich in the mineral elements. However, steps must be taken to correct their deficiency in nitrogen and active organic matter. This can be easily overcome by use of a crop rotation favoring leguminous plants, notably alfalfa."

Flooding of the bottom lands every spring by the Kootenai River make diking and drainage a major problem. Plans have now been perfected for the drainage of all the lands subject to overflow. Within the last ten years several thousand acres have been diked or have had drainage provided. In fact, one contract, let in April, 1931, covered the diking of 1,400 acres, 1,200 acres of which were in crop the same year.

FIGURE 4.—A dike and highway combined, a common sight in the Kootenai Valley. It is not uncommon to find the lesser roads of the various diked areas following the dike ridge. Thus the dikes serve a dual purpose of protection and transportation.

Agriculture and Agricultural Trends.—From a land of meadow pastures, wild hay, and limited cultivated crops in 1910, the Kootenai Valley has grown to become a highly productive wheat, oats, and alfalfa district. The only major limiting factor in this development is the expense of diking or draining additional areas (Figure 4).

Even though there is patch agriculture in many of the mountain valleys and on the mountain slopes, over 85 per cent of the agricultural products are grown in the Kootenai, Moyie, and Deep Creek Valleys. In the former case, many of those farming small patches of land de-

pend upon outside work to balance the family budget, or make improvements on the farm. The agricultural products supply only food for the family and the livestock. The men usually obtain work in the lumber camps, the mines, and on the valley farms, or else cut wood or poles to be shipped out to net a cash return.

In the five years, 1924–1929, the acreage of crop land harvested increased 90 per cent. However, during the same short period pasture lands decreased 20 per cent. The amount of woodland pasture decreased very little, while the plowable pasture land acreage was reduced from 6,000 acres to less than 2,000 acres. These comparisons tell the story of the shift to regular agricultural practices from the age of meadows and grazing, as well as the story of the great increase in total cultivated land (Figure 8). Nor has this remarkable growth been in acreage alone, since the value of farm lands and buildings have increased accordingly, the latter having increased nearly 100 per cent.

Accompanying these marked increases and changes has come the shift to the present type of agriculture, suggested previously, that of grain and alfalfa growing. There were over 13,000 acres of wheat threshed in 1929 as contrasted to 566 acres in 1919. Oats acreages increased from 559 acres in 1919 to nearly 2,000 acres in 1929. The remarkable average yields of 37 bushels of wheat, and 60 bushels of oats per acre attest to the high fertility of the soil.

The excellent soils, coupled with a climate favorable for hay production, have resulted in the planting of over 2,000 acres to alfalfa within the last ten years (Figure 5). In fact, nearly half the farms now have their fields of alfalfa. The alfalfa production has increased at the expense of the wild grasses that formerly constituted the major part of the hay crop. Their acreage has decreased from nearly 10,000 to less than 3,000 acres. In sharp contrast to the practices in more humid sections of the Washington Wheat Belt, we find practically no small grains cut for hay in the Kootenai region.

FIGURE 5.—A typical field of alfalfa being grown on recently cleared stump land. There has been a marked increase in the alfalfa acreages in the north Idaho counties. It is especially desirable not only because of its value for hay but because of its value as a soil builder.

Production of other grain crops, or other hays are of practically no importance. Field peas, raised for seed purposes, are grown on several farms. It should be noted that the industry has increased in importance and, with the climate favoring it, should result in great growth in the future (Figures 6 and 7). Potatoes and alfalfa are also grown for

FIGURE 6.—One of the many fields of peas grown for seed purposes. Since the climate is particularly favorable to high yields and production of seed of excellent quality, the seed pea acreage should continue to increase.

seed purposes. The north Idaho potatoes are especially prized for seed purposes and are also sold in large quantities to eastern hotels.

The Dairying and the Poultry Raising Industries.—Dairying has not grown in accord with regular agriculture although from 1919 to 1929 it gained 15 per cent. Nevertheless there has been a marked tendency to better the quality of the herds. In spite of the predominance of grain crops, the combined values of dairy products showed a total nearly equivalent to that of hay and forage crops and 15 per cent of the return from grains. The abundance of pasture in summer, and of hay for winter feeding, and the increasing alfalfa acreages are natural factors that should result in a considerable increase in the dairy industry within the next few years. Even now the region ranks high in number of cattle per farm, there being over 4,000, mostly for dairy purposes on the 426 farms.

The poultry industry is on the increase and should become important since there are grain crops at hand and there is a good market at Spokane and in the logging or mining camps near by.

In 1929 chicken eggs produced amounted to over $52,000, while $38,000 worth were sold. During this one year nearly $9,000 worth of chickens were sold. When we recall that there are but 426 farms we note a high return per farm. Little has been done in the coöperative movement, nor in standardization of products. This will be necessary before any but the local markets may be utilized to any extent.

Mineral Exploitation.—Boundary County is greatly blessed with mineral wealth. There are at least a dozen developed mines in the mountains on either side of the Kootenai Valley. However, none have been developed so as to be comparable to the Mullan-Burke District in Shoshone County. In many cases the ores, which are mostly silver or lead, have been of too low a grade or have not been found in large enough quantities to warrant large-scale operations. There are, nevertheless, several workings in either range that will undoubtedly be developed considerably with the return to normal of silver and lead prices. One placer gold mine on Boulder Creek, near Lenia, has been developed, but because of mismanagement and the resulting failure the enterprise is not now being worked to any extent.

THE PEND OREILLE VALLEY

On either side of the Pend Oreille, along its entire east-west course across Bonner County are numerous level or nearly level areas. Although there are several constrictions in the valley the bottom or bench lands extend back from one-half to a mile at several places along the river. The most notable extensions are on the north side of the river at the town of Priest River, eastward for several miles from Thama, at Laclede (Figure 11), and in the vicinity of Dover and Sandpoint. Elsewhere the glaciated mountain ridges may extend to the water's edge.

Included within this region is the district lying in the Pack River Valley in the Purcell Trench. This area is tributary to Sandpoint, the major urban aggregation. There are also minor settlements along the north shore of Pend Oreille Lake. They are located on remnants of glacial benches or on alluvial fans of the streams emptying into the lake.

Soils.—The Pend Oreille Valley bottom land soils are of high fertility. Bench land soils, though better drained and easily worked, are, in many instances, lacking in nitrogen. In most cases the soils are underlain with deep gravel deposits, thus making them well drained except in some lowland pockets or swamp areas.

These benches rise as steps, there being large areas of level or nearly level land on each one. Jones and Colver thus describe the Pend Oreille Valley, "The valley of the Pend Oreille is likewise broad, but the low-lying benches come so close to the river's edge as to enable one to describe the valley as rolling. A noteworthy exception to this description exists at Clark's Fork; there the valley resembles that of the Kootenai in topography. The soils of the Pend Oreille Valley are essentially low-lying bench soils, with occasional restricted districts of alluvium."

Climatic conditions are very similar to those in the Kootenai region with the exception that there is somewhat heavier precipitation here and that many of the larger level bench areas tend to be more susceptible to out of season frosts. Since the mountains to the south are much lower or totally absent, the flow of the few streams is more seasonal.

Agriculture and Agricultural Trends.—Wheat raising is not the major agricultural adjustment in the Pend Oreille Valley as it was in the Kootenai region.

FIGURE 7.—Another view showing broad expanse of high-test seed plots in the Kootenai Valley. The cool climate and fertile soils are highly conducive to the production of garden seeds.

FIGURE 8.—A bird's eye view of a typical Kootenai farm. This view, taken in District 7, shows a typical prosperous farmstead located on the level floor of the broad Kootenai Valley, with wheat yields of as high as fifty bushels per acre, on the diked lands near Bonners Ferry and northward.

Instead, one finds a greater range of products, there being no single one of outstanding importance. There is not the major problem of dikage since the area subject to overflow is much smaller and does not usually stay under water as long as the Kootenai lowlands.

Pend Oreille Valley agriculture may be divided into three parts with certain characteristic crops or industries in each group. They are: (1) The meadow land farms whose characteristic occupations may be dairying or raising of meadow hay to be sold to the logging camps. (2) The bench land farms where there is usually some hay grown along with the grain crops (Figure 10). There probably will be some chicken raising and possible potato growing. (3) The combination type, which is the most common and usually the most prosperous.

Wherever possible the owner of the stream-side meadows owns some bench land as well since the wild grass hay is not nearly of as high quality as the alfalfa. The increasing importance of trucks and tractors in the logging industry has lessened the number of horses used, hence has materially decreased the hay market (Figure 12).

The combination type and the better situated bench land farms net the greatest returns to their owners. It is here that we find the farmer growing grains for sale or for stock and chicken feed, alfalfa for sale or for winter feeding of his dairy herd, potatoes or other root crops for his herd. In addition to this there is the excellent meadow land for pasture later in the summer.

Only 20 per cent of the land in farms is being cropped, while the Kootenai Valley averages over 40 per cent. There are large areas of cut-over lands used for pasture. The acreage of the crop and pasture lands has increased but little since 1924. Of 22,000 acres devoted to hay crops in Bonner County over 13,000 acres were in timothy with alfalfa second. There has recently been a great increase in the alfalfa acreage.

The lack of importance of the grain crops may best be realized when we note that the combined oats (3,000 A) and wheat (1,884 A) crop acreage totalled but about one third that of the timothy acreage. This is in sharp contrast to the Kootenai, where grains predominated. It is largely because many of the farms do not have sufficient tillable areas to make grain farming profitable. This phase of agriculture must mark time until the over-worked woodsmen-farmers have completed the task of slashing, stumping, and making plowable the remaining portions of their farms. Even then, if the present trends continue, it is

doubtful if the grain growing stage will ever materialize, since dairying with its demand for alfalfa hay is already well developed and is increasing rapidly.

Several coöperative associations in Bonner County aid the farmers materially and have been partly responsible for the impetus given the dairy industry.

Of the 4,500 cattle on the Bonner farms, over 90 per cent are of the dairy type. The dairy products sold in 1929 alone were valued at over $265,000. They represent the phase of agriculture netting the greatest cash return to the farmers, hay being second, and poultry third.

Though many a woodsman has scoffed at the idea of buying grain for his wife's flock of chickens, her persistence has no doubt been partly responsible for the present high rank of the industry. But now that he recognizes the chicken as a dependable source of income is evidenced by the increased flocks and the scientific methods employed. In fact, in some instances men who haul wood to the Spokane Valley make it a practice to include a case of eggs every few days as a part of the cargo. The great growth of the industry is shown by the gain of 60 per cent in the number of chickens from 1919 to 1929. At the same time the number of eggs produced increased over 110 per cent. The effect of the Spokane markets and the growth of local markets is shown by the 300 per cent increase in the number of chickens sold alive or dressed. No doubt the industry will continue to gain in importance as the coöperative movement becomes more widespread and the standardization of products becomes more established.

FIGURE 9.—Looking northward up the Purcell trench. The famous Kootenai Valley lies at the foot of the mountains shown on the left side of the view. This view shows admirably the varied landscape of dense forest growth with the numerous clearings. (Courtesy of Great Northern Railway.)

On the rolling bench lands or the slopes, as well as near Pend Oreille Lake, one may see many orchards. Though small, they nevertheless furnish practically enough fruit to supply the local demand. A few large orchards along the lake usually export several cars of apples. Due to the severe winters the fruit crops are practically limited to cherries, apples, and pears. A few grapes are grown, but they are not of any importance as an export or market crop, most of those used in the area being imported from the

irrigated section of Washington. Except for the occasional out of season frost the berry crops would undoubtedly become important. Despite this hindering factor a large percentage of the farms have small berry tracts to supply home and local markets. Raspberries and strawberries are most common. Since there is not sufficient production within the areas the price is kept very high. Additional berries are usually shipped in from the Spokane Valley.

tary to the lake has remained practically undeveloped it should develop into a very prosperous area. There are large meadow land areas, most of which are covered with dense stands of western conifers awaiting the coming of the woodsman.

There has been a marked influx of population into the region the last ten years. Stage lines now connect Coolin, at the south end of the lake, with the city of Priest River. Dirt roads have been

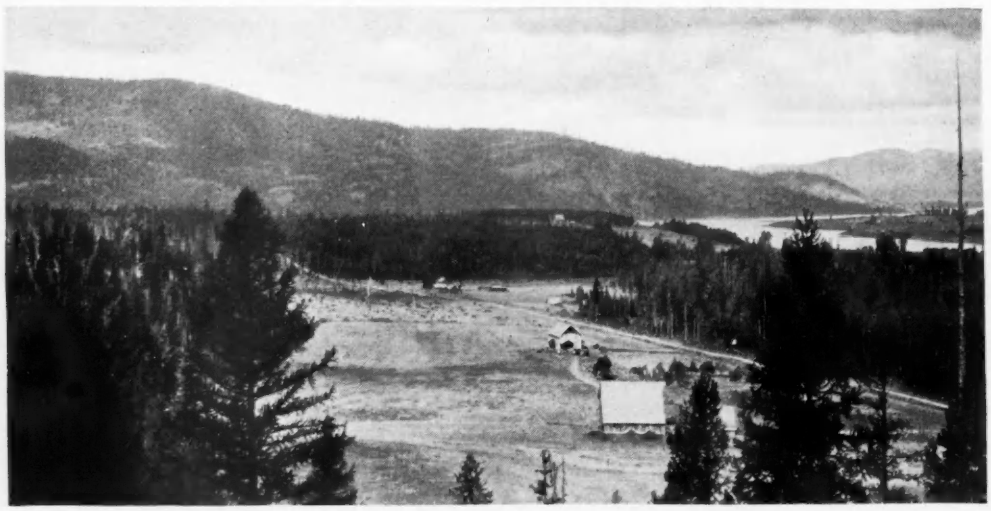

FIGURE 10.—A Pend Oreille bench land farm. This view, taken from the summit of a low ridge back about a mile from the river, shows a typical bench land adjustment on the sand or gravel benches found alternated on either side of the stream. We are looking west toward the town of Priest River. The Pend Oreille River is in the background.

PRIEST LAKE BASIN

One of the most picturesque lakes in the northwest lies in the heart of the western arm of the glaciated and stream carved Selkirks (Figure 13). Priest Lake, twenty-five miles in length and averaging three miles in width, is famous as one of the last outposts of wild life. To this spot sportsmen, intent upon a real hunting or fishing trip, journey from eastern Washington and many parts of north Idaho to enjoy the pleasure and change from the hustle-bustle of civilization.

Although as yet the large basin tributary extended up either side of the lake for several miles. At last the lower basin shows signs of civilization as scattered clearings dot the landscape.

It is here in the most northwest corner of the state that we find one of the largest and purest stands of western white pine in the United States (Figure 14). This district vies for honors with the great Clearwater Basin stand tributary to Lewiston. So important is the lumbering and its possibilities in this district that recently 6,000 acres have been set aside for a forest experimental station. Disastrous fires the last three years in the lower basin in the West and East

Branch districts have resulted in great losses. However, the major large blocks of higher grade timber have not been touched by the ravages of fire.

Undoubtedly Priest Lake will long remain a favorite retreat for the hunter or fisherman. The near by lands will take on the typical patched appearance, and dairying and poultry raising will follow the exploitation of the forests. However, the day when agriculture will become important lies well into the future.

HOODOO AND COCALALLA GLACIATED DEPRESSIONS

Located midway between the Pend Oreille Valley and the Rathdrum Prairie is a broad belt of typical ice-scoured, or deranged drainage swamp land. In the Cocalalla Valley, a part of the Purcell Trench that extends southward from Sandpoint, are extensive areas of semi-swampy meadows and low bench lands.

Man's adjustments are here as varied as in the Pend Oreille. Here, as there, we find the two types of land as well as boulder strewn ridges or gullies or low ice-scoured ridges. Most all of the region has been cut over so that now only second growth or slashings remain.

Extending the entire length of the Cocalalla Trough, along the railroad, is a chain of small villages, or typical cross-road stores. It is here that the woodsman-farmer trades his poultry products or butter for his supply of groceries. Ofttimes, perhaps, he ships a can of cream to the Sandpoint or Spokane creameries to realize a cash return.

The Hoodoo Trough, which swings in a northwest direction from the southern tip of the Cocalalla depression, presents a similar picture with similar conditions. Despite the general similarity, the Hoodoo has a much smaller acreage under cultivation, has but three country store sidings, and has a much smaller population.

FIGURE 11.—Laclede, Idaho, a small town built on the bench land. Once a thriving mill town, but now just a community with the customary country store and service stations since the large sawmill burned a few years ago. The Pend Oreille River can be seen just beyond the town. The mountains to the left form the northeast boundary of the Hoodoo depression while the lowland to the right is the mouth of the Hoodoo where it empties into the Pend Oreille.

FIGURE 12.—Typical logging scene in north Idaho where trucks and tractors have displaced horses. This facilitates transportation of the logs during any season of the year. Note the glaciated topography in the background.

Along with the sinuous meadow or swamp land district are several thousand acres of boulder strewn land that will never be of any value except for native grass or clover pasture, although it is relatively level. A large part of the area presents a desolate appearance because much of the beautiful second growth stand in the upper valley has been destroyed and blackened by fires, while most of the remaining district has been cut over.

RATHDRUM OUTWASH PLAINS

The Rathdrum Prairie Region slopes gently from its northern boundary at the rim of the Hoodoo depression toward the Spokane River. It presents a typical plains appearance, being nearly level, having a gentle slope, and including several minor depressions evidencing an old glacial stream channel. This large district, containing at least 1,000 square miles, was formed by the waters from the ice lobes as they receded up the valleys to the northeast.

Man has found here a great variety of soils. The entire region has profited somewhat by loess deposition resulting from the numerous "dust storms," originating in Central Washington, that reach the district. The predominating soils are black or dark gravelly silt loams. Large areas have never been

FIGURE 13.—In the heart of the mountains, beautiful Priest Lake. It is here that the fishermen find one of the few remaining lakes untainted by commercialism. The glacial rounded ridges can easily be seen in the background. (Courtesy of Frank Guilbert.)

timbered and do not have the acidity noted in some of the timbered soils. However, conditions are not all favorable since the land is very gravelly or boulder strewn or may have thick coarse gravel layers so near the surface as to result in rapid drying out of the soil.

The northern division, known locally as "Eight-Mile Prairie," as well as the district adjacent to and east of Rathdrum, have been under cultivation many years. The Spirit Lake section consists largely of cut-over lands with human adjustments comparable to those of the Hoodoo.

Wheat farming is of major importance, since here again the acreage of tillable land on most of the farms warrants grain production. The rainfall, which averages but 20 inches annually, has been a limiting factor to hay production. The unreliable growing season, coupled with the difficulty of obtaining water for irrigation, has also limited fruit raising. As a result, the fruit raising districts of the Spokane Valley on the southern margin of the prairie give way to fields of grain as one goes northward from Coeur d'Alene.

FIGURE 15.—A five-foot cedar, a 30-inch cedar, and a three-foot white fir.

Figure 14.—A clump of majestic white pine, Idaho's pride. Millions of feet of this valuable evergreen remain untouched in several sections of the North Idaho Panhandle. The white pine is especially prized for use in the match industry and as a better grade of softwood lumber that does not split easily.

Market conditions favor dairying. Despite the hindering factor of limited hay production and the absence of "all summer" pastures the industry is on the increase, most notably in the small valleys lying on the margins of the prairie region. Hay can be easily imported from the Spokane Valley. Poultry raising is fast gaining the rank it should hold in the area since the grain production and nearness of markets are greatly in its favor.

A consideration of the Post Falls-Coeur d'Alene section should, from the geologic viewpoint, be considered with the Rathdrum Prairie. Despite its formation by glacial outwash and stream laid gravels, the major industries of ir-

rigated fruit raising and vegetable growing, with power and lumber industries, place it in the Spokane Valley region, which is not to be treated in this survey.

LUMBERING IN THE NORTH IDAHO PANHANDLE

Standing side by side with the great St. Joe-Clearwater-Selway forest belt of the east central panhandle, the Bonner-Kootenai-Boundary forests stand paramount in the northern Rockies. For over three decades the forests have been the basis of prosperity in this entire north Idaho region. Even now, excepting only the agriculture of the major valleys, the lumbering industry dominates the area. Two of the major National Forest Reserves are found within its boundary. Over 90 per cent of the towns or villages owe their existence to the industry. They may be supply villages or else the home of one or more large sawmills.

FIGURE 16.—"Buckers" cutting a large white pine into log lengths. Note the density of the vegetation and the proximity of the valuable trees. (Courtesy of Rutledge Lumber Co.)

FIGURE 17.—A close-up of a less prosperous farmstead located at the foot of the mountains. Many such farms, where there is poorer soil and more of a problem of clearing, stand out in sharp contrast to the valuable Kootenai farms.

The western white pine, the most prized of western woods, is found in almost pure stands (Figure 14). Over large areas the forests are of such quality as to average 90,000 board feet per acre (Figure 16). The wood is used for boxes, match blocks, and better grade finishing lumber. Second in quality to the white pine, but ranking high in value are the cedar, fir, and tamarack (Figure 15).

A special phase of the lumbering industry, the preparation of poles and piling, occupies a prominent place. In 1929 60 per cent of all poles or piling cut on farms in Idaho were cut in the three northern counties, over 50 per cent being from Bonner and Boundary. Bonner County cedar, fir, and tamarack poles are in demand throughout the northwest.

The making of railroad ties is also very important, 50 per cent of the state's entire output being from these two counties. In the value of forest products cut on farms for sale or home use, Kootenai and Bonner Counties hold undisputed sway in heading the list. The holder of third place is some $20,000 behind Bonner, which is on practically even terms with Kootenai with a $125,000 total.

Thus we find there are two major classes of operation: (1) There are the wholesale logging operations of the large companies. (2) There is the forest exploitation being carried on by at least 60 per cent of the rural population who are cutting wood, posts, poles, or saw logs on their farms. Usually the second stage follows the company logging program.

TRANSPORTATION AND CITIES

There are but two urban aggregations having over 1,000 population. The two major cities, Sandpoint located on Pend Oreille Lake and Bonners Ferry in the heart of the Kootenai Valley, are trading centers for large tributary areas. In both cities are located large sawmills and creameries. Sandpoint, the larger of the two, is visited by three main line railroads, namely, the Northern Pacific, the Great Northern, and the Spokane International. Included within its trading area are Dover and Kootenai, each the home of a large sawmill and located within a few miles of Sandpoint.

Three other towns of note include Priest River, noted for its lumber, poles, and dairy products; Spirit Lake, a lumber center; and Rathdrum, a trading center for the Rathdrum Prairie district adjacent to the city.

The entire region is well served by improved roads or excellent highways. It should be noted that three surfaced roads cross the Rathdrum section, while there are improved highways up the Pend Oreille Valley, the Kootenai and Moyie Valleys, and the Cocalalla depression. Since graded dirt roads as connecting links are numerous, there is practically no isolation except in the most mountainous districts.

CONCLUSION

The story of the development of the North Idaho Panhandle is typical of an area of forest exploitation. The story of the woodsman-farmer is one of hard work with but a fair living in return. The story of the logger is that of the typical woodsman whose prosperity depends upon the rise or fall of the lumber market.

Favorable physical and economic conditions combine to greatly add to the possibilities of further successful development. Thus, if the great stands of virgin timber are not protected by a conservation program, and become exhausted, the district will develop into an excellent farm and dairy region, never to become an unused waste or region of land abandonment.

AGRICULTURAL LAND UTILIZATION IN DENMARK

Daniel R. Bergsmark

THE natural and cultural landscapes of Denmark vary from place to place, yet there are factors which tend to give the whole country certain distinctive characteris-

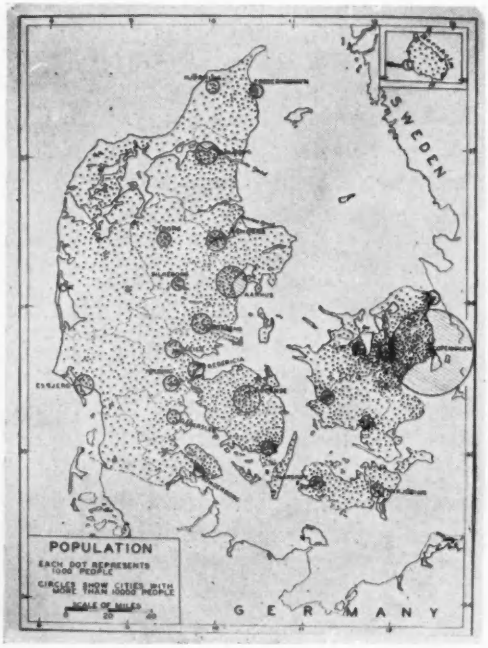

FIGURE 1.—The population distribution of Denmark. Note the concentration of cities in the eastern part of the country.

tics or elements of uniformity. Thus, although there are irregularities in the relief and a number of topographic types are found, no part of Denmark is more than 510 feet above sea level, and the entire land surface shows the effects of glaciation. In some places level, sandy outwash plains; in others clayey ground moraines; and in still other areas the terminal moraines are impressive features of the landscape. The drainage pattern further bears witness to widespread glaciation, as indicated in the number of glacial lakes, swamps, and marshes. In some places marked striations on the underlying rocks show the direction of movement of the glacial ice, whereas the types of glacial débris and boulders suggest their probable source of origin.

THE DANISH LANDSCAPE AND ITS GENERAL FEATURES

The natural vegetation, though occupying a small part of the present landscape, indicates that forests were widespread, and indeed covered the greater part of Denmark. But in this small country the pressure of population upon the land early caused a shrinking of the forested areas as agriculture expanded. Of the 750,000 acres of remaining woodland the greater part is found in Eastern Jutland and in the Danish Islands, especially Seeland, Laaland, Falster, Fyen, and Bornholm. Where forests occur, a conservative policy of exploitation is followed. As the trees are felled new ones are planted, and in Western Jutland large plantations of red and white pine have been established during the last three decades. In the Danish landscape the most common and widely distributed tree is the beech, and next in importance is the red pine. These trees are generally found on the well-drained lands, whereas ash and birch are seen in many of the poorly-drained forested districts. The three largest forests in Denmark are Grib Forest on the island of Seeland, Rold Forest in Jutland, and Almindingen Forest on the island of Bornholm. In the very sandy, level tracts of Western Jutland the soil and subsoil favor the growth of heather rather than forest, and in some districts the so-called "white

sand dunes" are suggestive of a paucity of native plants.

Into this natural setting of glacial land surface and distinctive vegetative types is woven a cultural landscape which clearly reflects the importance of agriculture, especially the dairying industry. The widespread importance of this industry is noteworthy. Dairy cows, hogs, and poultry are seen in the western heath lands, in the districts of recently elevated sea bottom (Northern Jutland), as well as in the till plains of Eastern Jutland and the Danish Islands. The entire cropping system is planned to provide forage and feed for these farm animals. The crops, however, vary in kind and in yield per acre from place to place.

FIGURE 2.—Dune topography characteristic of the western part of Denmark. (Courtesy of Jonals Co.)

The careful observer is also impressed with the generally small size of the Danish holdings. Approximately one-half of all the agricultural holdings of Denmark cover less than 25 acres each, and 43,000 of these small farms are less than 8 acres in extent. (Statistisk Aarbog (Statistical Yearbook) for 1930, Copenhagen, Denmark.) Farms of more than 640 acres each cover less than 10 per cent of the total area of the country. These miniature farms stand in sharp contrast to the large grain-producing estates which characterized Danish agriculture before the last quarter of the nineteenth century. Unable to compete with the grain production of the extensive, fertile, level lands of America, the Danish farmer turned to the dairying industry and, therefore, to a more intensive agriculture. The state forced the subdivision of large holdings, and it has been a principle of Danish leaders that "very few should have more than they need, and fewer still should have less than they need."

In this country with its extensive areas of coarse soil and marine climate, the land must be utilized intensively. Unlike the North Central Dairy Region of the United States, where cattle are permitted to roam at large, tramping the pastures under foot, in many parts of Denmark cows are staked in the pastures so that there will be a minimum of waste. In other places, the animals are kept within inclosures on the farmsteads, where they are supplied with feed during the entire year.

An impressive part of the cultural pattern are the well-kept farmsteads, with their neatly apportioned frame buildings, explaining in part the world's increasing appetite for Danish butter, bacon, and eggs. Although the farmstead at present is part of almost every Danish farm, it constituted part of a village or urban landscape during the time of the large estates, when agriculture

was extensive rather than intensive in character.

The cultural landscape of Denmark's urban areas reflects a number of old trade centers near the coast, on rivers, or along the innermost ends of fjords, which afforded protection to the inhabitants and favorable anchorage for ships. Such cities were established mainly in Eastern Jutland and the Danish Islands, where a large number of fjords afforded a favorable site and situation for such development, as contrasted with the generally uniform sandy, harborless coasts of Western Jutland. Some centers were located on rivers which were navigable for the ocean-going vessels of former years, but are now too shallow for even the smallest of tramp vessels. Among such centers are Naestved, Odense, Grenaa, Ribe, and Varde (Figure 1). Other cities developed in the neighborhood of a strong fort or castle, which could furnish protection against sea-robbers and pillage. The names of some of the Danish cities reflect such origin, as for example, Nyborg, Kallundborg, Vordingborg, and Viborg, borg being the Danish word for castle. In general, the early centers were located near the coast, since the people depended to a large extent upon the sea and its products as a means of livelihood. However, within the last century most of the cities have developed at points favorably located with respect to rural lands and manufacturing. The latter influence is nicely illustrated at Silkeborg and Frederiksvaerk, where the construction of factories preceded urban development.

FIGURE 3.—The surface features of Denmark. (After Ussing, Andersen, Vahl, and De Geer.)

GEOGRAPHICAL UNITS

Although Denmark's natural and cultural landscape features contain certain elements of uniformity in that (1) the land surface in general shows the effects of glaciation and varies but little in relief from place to place and (2) that dairying is the dominant and most widespread economic adjustment to the environment, there are, nevertheless, also striking differences in the landscape. On the basis of physical differentiation, one may recognize certain well-defined units, which essentially coincide with (1) Western Jutland, (2) Northern Jutland, and (3) Eastern Jutland and the Danish Islands.

THE LANDSCAPE OF WESTERN JUTLAND

Western Jutland contains certain elements of simplicity in its natural setting, its land forms consisting mainly of three types: (1) isolated hill-islands, (2) heath plains, and (3) sand dunes. Along the western essentially harborless coast one finds sandy reefs and dunes, the dune topography extending some ten to fifteen miles inland (Figure 2). Just beyond the dunes are the heather hills and the heath plains. These plains are the most extensive level areas in Den-

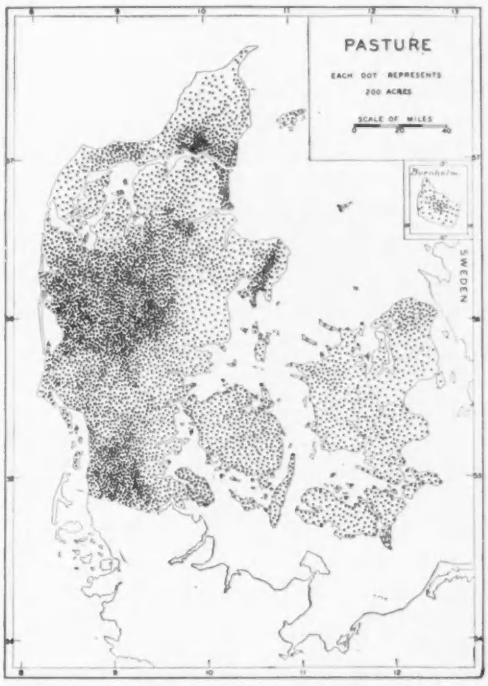

FIGURE 4.—The distribution of pasture in Denmark. (Based on census returns from the Statistiske Aarbog, Copenhagen, Denmark, 1930.)

mark, and consist mainly of sand, which was carried away from the edge of the glacier during the recent Ice Age. This sandy material filled the valleys and left the hills of former glacial periods as islands of various sizes in the midst of heather-covered plains (Figure 3).

The natural vegetation in this part of Denmark varies from place to place, but two major indigenous types predominate (1) forest and (2) heather. By reason of its sandiness and subsoil characteristics, the heath plains are the home of plants called heather, some of which consist of small, very hardy evergreen shrubs, whereas others may be classified as heath grasses. The hill-islands, on the other hand, were forest-covered until cleared for crops. But there has been some reforestation in certain of these western parts of the country within the last half century. A few large plantations of trees have been established and at present some of them contain merchantable timber. A few of the plantations have been set out even in the area of dune topography in the extreme west and on heath plains. The trees consist mainly of red pine, although this tree is less able to withstand severe winds, as compared with the white pine and the highland fir, which therefore displace the former in severe windward exposures, especially in the extreme western dune-covered districts.

AGRICULTURE

The agricultural production of Western Jutland is generally less intensive than that found in the eastern parts of the country. The cultural landscape reflects a more scattered distribution of farms, more permanent pasture, and a smaller percentage of land under cultivation than one may find on the heavier clay loam soils of Eastern Jutland and the Danish Islands.

The most productive cultivated areas

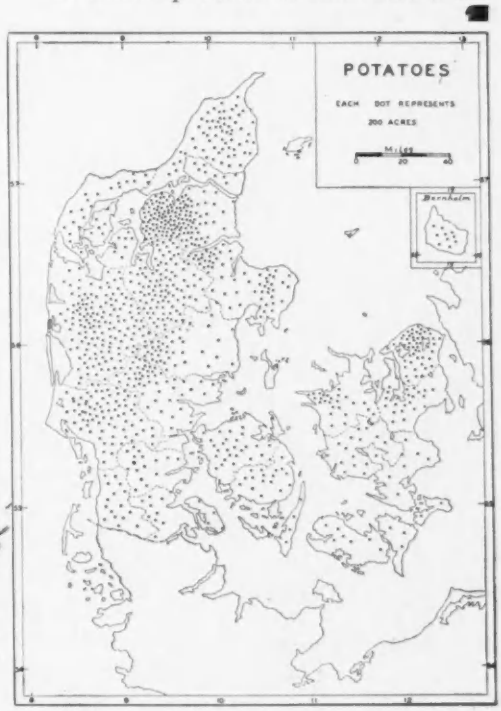

FIGURE 5.—Distribution of potatoes in Denmark. (Data obtained from the Statistiske Aarbog, Copenhagen, Denmark, 1930.)

occur in the river valleys and on the hills of the region, especially where the soil contains a relatively large amount of clay. Within the valleys, moreover, the chief agricultural villages and trade centers have sprung up. The sandy heath plains, on the other hand, help to explain the more widespread occurrence of pasture in this part of Denmark (Figure 4). During periods of drought the soils of these sandy western districts are unable to retain their moisture and large areas are still occupied by heather shrubs and grasses, which are utilized as natural pasturage. Yet, with the application of manure and marl some of the heath plains have been improved sufficiently to yield moderately good returns of grasses, grains, and tubers (Figure 5). In general, the hay crop covers more land than any other, whereas the most widely grown cereals are oats and rye (Figure 6).

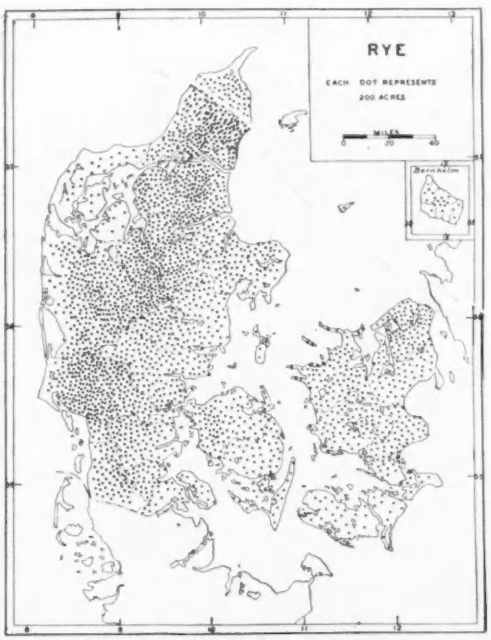

FIGURE 6.—Among the cereals grown in Denmark, rye occupies a place second only to oats.

SUBSISTENCE AGRICULTURE AND FISHING

The coastal parts of this region contain belts of cliffs (Figure 7), sand dunes, and scattered areas of marsh. Among the cliffs and in leeward locations with respect to the westerlies, a number of people have built their small houses, and depend upon the products of the sea as well as those of the land for a livelihood. Their livestock generally consists of a few sheep and a cow or two per family. At rare intervals small and irregular cultivated areas interrupt the continuity of sand, steep clay cliffs, and marsh. Grain fields may be seen only in a few places, and their yields are distinctly lower than those obtained in other parts of Denmark.

PORT DEVELOPMENT IN WESTERN JUTLAND

Although it is especially favored with respect to North Sea trade, Western Jutland is handicapped in various other ways to such an extent that it contains but one city (Esbjerg) with a population exceeding 10,000 (Figure 1). This western region lacks good harbors. In some places the coast is sandy, and contains large dunes; whereas in other places steep cliffs, such as those at Bovbjerg, constitute impediments to commercial development (Figure 7). The cliffs are found mainly in the northern part of the western coast, since this area has been rising while the southern part of west-coast Denmark has been sinking during the last two thousand years. In general the entire western coast of the country has shallow waters and does not favor port development.

Only along the quiet coast in the lee of Fanö Island have environmental conditions favored the development of a good artificial harbor. Since tides are well developed in this coastal area, the harbor has been so constructed that it can be locked with a huge gate, thereby preventing the escape of the water in the

harbor. Its one major excuse for being is that somewhere on the west coast a harbor was needed where the trains that bring the rich agricultural exports of Eastern Jutland and the Danish Islands could meet the ships that carry those exports to various parts of the Commercial World, especially Britain. Moreover, Esbjerg has become the western terminus of the steam railway-ferries which carry loaded trains across the various straits from Malmö, Sweden, via Korsör, Nyborg, Stribe, and Fredericia.

FIGURE 7.—Cliffs in the northern part of west-coast Denmark. This area has been rising while the southern part of the coast has been sinking during the last two thousand years. (Courtesy of Jonals Co.)

A study of the urban landscape of Esbjerg discloses tall brick buildings and straight streets, which stand in marked contrast to the generally crooked streets and old structures found in Ribe and various other old cities in Denmark. This urban landscape reflects the youth of Esbjerg, the city being a recent creation in which modern planning is much in evidence.

NORTHERN JUTLAND

As a geographical subdivision of Denmark, Northern Jutland is distinctive by reason of the fact that it contains extensive stretches of recently elevated sea bottom. Since the last glacier visited Denmark, large parts of this region have experienced elevation considerably above sea level (during Fyrreskovstid), then submergence, which again was followed by elevation of the land, so that at present large marine flats cover extensive areas in Northern Jutland. Evidences of former submergence are found in the present landscape of these moist level plains, as reflected in the remains of marine forms, especially shell animals, found in the soil and subsoil and in places also at the surface. Elevated but a few meters above sea level, some parts of these plains are poorly drained, as is indicated where extensive moors have been formed, such as the well-known Lille and Store Vildmose. Where properly drained, these marine plains constitute a moderately good geographical base for agricultural activities. Their soils are more fertile than those of the heath plains of Western Jutland by reason of low elevation, nearness to ground water, and supply of lime (from shell animals). Consequently, during years of deficient rainfall these lowlands yield abundantly, whereas crop failures are common on the sandy heath plains of Western Denmark.

FIGURE 8.—Landscape in southern Seeland. This eastern part of Denmark is characterized by more fertile, heavier soils than are commonly found in western Denmark. (Courtesy of Jonals Co.)

As in Western Jutland where the hills extend as islands above the heath plains, so in this region, many of the hills stand as islands in the midst of marine flats. But Northern Jutland consists chiefly of undulating to rolling areas, where the glacial materials contain a preponderance of sand. These sandy to sandy loam districts are generally considered less fertile than most of the crop lands of Eastern Jutland and the Danish Islands.

LAND UTILIZATION

In this region agriculture constitutes the chief source of wealth and is the dominant activity of the inhabitants. The keynote of the agricultural system is dairying, and this theme is disclosed in the high percentage of cultivated land given to crops such as hay, oats, and tubers. Thirty per cent of the cultivated land is planted in clover and timothy, about half of which is cut for hay, the other half being used as pasture, mainly for dairy cattle and hogs. Similar to other parts of Denmark, this region possesses ideal conditions for permanent pasture and for the growth of hay, since it is part of marine Europe where cool summers, high relative humidity, and adequate rainfall favor the growth of grasses. The recently elevated marine plains are sufficiently moist, and good yields of hay are obtained even during dry years, when crop failures are common on the sandy plains of Western Jutland. In addition, the presence of marl favors the establishment of legumes.

Approximately 17 per cent of the cultivated land is devoted to oats, another crop characteristic of marine regions. Oats, like hay, occupies an important

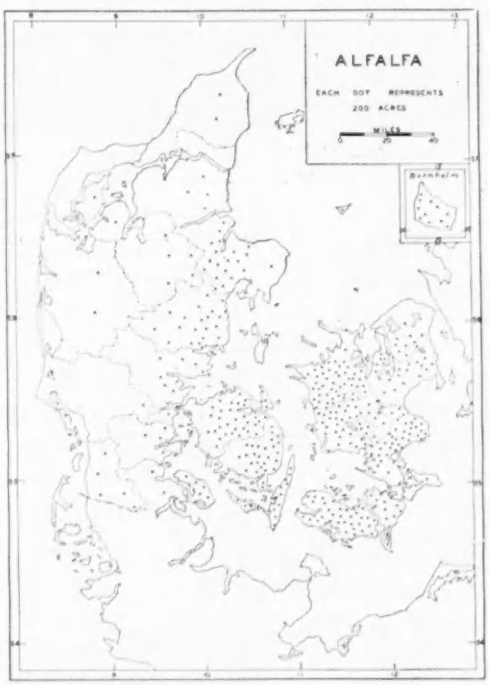

FIGURE 9.—The distribution of alfalfa in Denmark shows a general paucity of this crop on the sandy soils and under the marked marine conditions of the western districts.

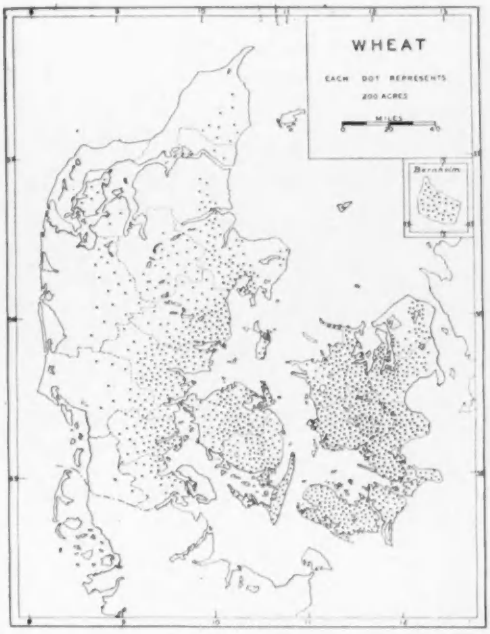

FIGURE 10.—The clay loam soils and the more continental climatic influence in eastern Denmark account for the pronounced concentration of wheat in that part of the country.

place in the rotation and constitutes a necessary feed for livestock. Of the cereals, rye is second only to oats, and is best developed on the sandy soils of the region. In addition, barley occupies an important place in the cropping system and serves as a moderately good substitute for maize; since the feeding value compares favorably, and the latter crop is not suited to the cool summers experienced in this region.

EASTERN JUTLAND AND THE ISLANDS

Eastern Jutland and the Danish Islands may be grouped together from the standpoint of our present study, since they possess certain common characteristics. Here the surface features reflect the fact that during the last glacial epoch the border of the ice remained for some time in a north-south direction, essentially in central Jutland (Figure 2). The subsequent deposition of débris by the rapidly receding ice suggests an explanation for the widespread occurrence of till plain or ground moraine in this region. The great variety of striated and wedge-shaped boulders of Swedish origin and the direction of striations on underlying rocks indicate that the advance of the glacier in this region must have been from east to west, and the retreat was apparently in an eastward to northeastward direction.

One of the distinguishing characteristics of the geographical base of Eastern Jutland and the Danish Islands is the preponderance of clay and clay loam in the soil and subsoil—a fact commonly overlooked when reference is made to the uniformly sandy surface of Denmark (Figure 2). This widespread distribution of clay suggests that the receding glacier left large till plains and moraines composed of materials originally brought from the limestone rocks of Skane, Sweden.

By reason of the more fertile soils,

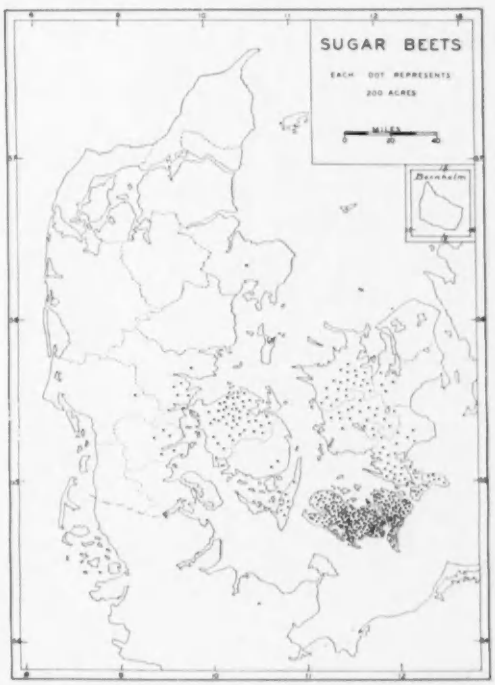

FIGURE 11.—Sugar beets show a marked concentration on the Danish Islands, especially Laaland and Falster.

this part of Denmark has a higher percentage of cultivated land than is found in any other division of the country (Figure 8). Moreover, the distribution of alfalfa, wheat, and sugar beets (Figures 9, 10, 11) further attest the better soil features of this eastern part of the country, but climate also plays an important rôle, especially in the case of wheat, a crop that finds Western Denmark too moist and cool for satisfactory production.

BOOK REVIEWS

BEAVER, STANLEY H., AND STAMP, L. DUDLEY. *Africa; A Regional Geography.* Part II, The University Geographical Series. iii and 271 pp., maps and charts. Longmans, Green & Co., New York, 1934. Price, $2.60.

Though the second in the series, this volume on Africa is the last to appear. Delayed by the inability of Doctor Stamp to make the personal survey and study of Africa that he desired in preparation for the book, it remained the unfinished part of the series until Mr. S. H. Beaver undertook its completion. It has always been Doctor Stamp's rule to acquaint himself thoroughly with any region about which he wrote, and having found himself unable to visit most of Africa except the northernmost and southernmost parts of that great continent, he acceded to the requests of his publishers for an early book on Africa by delegating to Mr. Beaver the work. The demand for the book on Africa had become insistent, Doctor Stamp was leaving for a year's study of America, and no plan seemed feasible to enable him to do the task himself.

The high standard set in the earlier volumes published is maintained in Part II. Part I dealt with the Americas in a most concise and illuminating way. Though by no means exhaustive in its treatment of the two Americas, it forms a useful basis for any course dealing with them. Perhaps not adequate for students in either of the continents, it certainly suffices for students elsewhere, who are not so directly concerned with American affairs. The point of view is well taken, the material is factually rich, and the presentation is interesting.

Part II, which is the volume under immediate review, constitutes the kind of book on Africa which American geographers will surely welcome, because it is so compact, so carefully organized and prepared, and because it presents the essential facts relating to every part of Africa so interestingly. More exhaustive and comprehensive books would probably prove cumbersome and entail the use of too much time to be popular with the rank and file of teachers and students.

Australia and New Zealand are just as compactly and satisfactorily treated in Part III. With equal clarity and with equal emphasis, Doctor Stamp has brought out the significant elements in the geography of these antipodal lands, all too little and all too indefinitely known by most of our American geographers. Doctor Stamp's book will supply the need.

The vast expanses of Asia form the subject of the treatment in Part IV. This volume may prove the least satisfactory of the series. Not because Doctor Stamp has not organized his material so well or has not taken as great pains to make it just as valuable as the rest of the series, but because the wide extent and variety of the Asian regions do not permit the same adequacy of treatment in so compact a volume; but I would not have this criticism construed as pointing out a defect in the treatment; it is merely a deficiency in the book due to the vastness of the continent about which it deals.

Part V deals with Europe and the Mediterranean. It is the bulkiest, the most exhaustive, the most detailed, and the most illuminating of the series. The greater interest in Europe and its affairs, particularly among British geographers and students for which the series was written, the richer store of literature available for every region of the area covered, the wider influence that Europe exerts upon world affairs, combine to enforce upon a European geographer more extensive treatment than he can proportionally afford to other continents. It constitutes a compact compendium of European regional geography.

Accordingly I would accord to the series a most favorable place in the regional geographical literature of the day. The series is intended for higher school and intermediate courses. It should prove exceptionally valuable in our advanced courses in high schools; in regional courses in teachers' colleges and normal schools; and in the earlier courses in colleges. It has distinct value in its compactness of treatment, its excellent organization, and its authenticity. It may not serve so valuably for reference purposes, but it will more than compensate for that limitation by indicating the essential facts in the regional geography of the continents. Best of all the cost of the series is not only not excessive, but well within the compass of the modest funds of the schools that will find it most useful.

Africa, the continent discussed in Part II, which occasioned this review, has been all too little known, or too vaguely known, to receive in American geography courses the attention it increasingly deserves. This book emphasizes the salient points of its geography in a way that insures authority and adequacy of treatment by any teacher using the series.

All the volumes are well bound, printed upon good paper, and set in clear, legible type. The series is a valuable and distinct asset to our students and teachers.

W. ELMER EKBLAW

FINAL REPORT OF THE COMMITTEE ON LAND UTILIZATION. *Land Utilization in Minnesota; A State Program for the Cut-over Lands.* xiv and 289 pp. Published by the University of Minnesota Press, 1934. Price $1.50.

JESNESS, OSCAR B.; NOWELL, REYNOLDS I., AND ASSOCIATES. *A Program for Land Use in Northern Minnesota; A Type Study in Land Utilization.* xvi and 338 pp. Published by the University of Minnesota Press, 1935. Price, $2.50.

Both these volumes represent a pioneer attempt to set forth as clearly and forcefully as possible a phase of economic and geographic thought and planning which has swept our country within the last few years, and about which inadequate facts have been gathered, inadequate consideration has been given, and inadequate conclusions drawn.

The world is seeking a panacea for its economic ills, and its social and political neurasthenia, some elixir pleasant to take and gentle in its effect; just at present it has seized upon economic planning, and land utilization, and attendant nostrums, as offering the most agreeable deodorant, disinfectant, and cure-all. That all these newly-vaunted medicines have their virtue, no one can reasonably doubt; but compounded, dispensed, and administered by untrained, incompetent, or quack doctors they may prove more disastrous than the disease they are taken to cure. Imperfect preparation, improper dosage, and misdirected application are likely to create disorders that the body politic may find difficulty in enduring or surviving. Beneficial as they may be when their effects are known and understood, when they are administered wisely and with reasonable knowledge of their results, they should not be used except under competent direction.

Together these volumes represent an attempt to determine the troubles that must be treated, the kind of planning that offers greatest likelihood of success, and the results that may be expected to follow. Both reveal intensive study of the problem and the possible ways of its solution. Both have been undertaken with the honest purpose in mind of relieving want, alleviating pain, and reducing distress. Both indicate, by their local application, the appreciation that the problem is in part local, and locally distinctive, even though of a part in a world-wide puzzle.

The first volume does not pretend to be the outcome of an intensive investigation; it is merely a report of recommendations based upon knowledge that was already at the hand of the committee in charge, without any attempt at additional, original research that might throw further light upon the problem. The committee did dig deep into the whole situation so far as that situation was known at the time, and into the apparent causes that had led to the reversion to the state of millions of acres of tax-delinquent, cut-over land in Minnesota, and the effect of that reversion upon the economic activity and social order of the district directly affected, and upon the resources and development of the whole Commonwealth. The problem it attacked is part of the problem that faces the states of the whole Eastern Forest Belt—the wisest utilization of the lands from which the pristine forest was mined, and the resources remaining are too meager and monotonous for human occupancy with any reasonable standard of living for the people.

The second volume carries the work farther, and presents the results of an intensive, original investigation of the section of Minnesota directly affected, an investigation that applied the best criteria available today, and the wisest principles yet formulated. The authors do not pretend to have spoken the final word on the subject, but with no illusions as to the uncharted course they have followed, they modestly affirm that they have presented it as an introduction to a better appreciation and comprehension of the problem.

It is in such spirit that such work as this must be undertaken. The symptoms of the depression are plain enough, but the disease that causes them is baffling; the illnesses of the cut-over lands are obvious, but the cure for them may not yet be discovered. I am in no position to judge the intrinsic merit of the investigation, but I have no hesitancy in saying that it is a step in the right direction.

The ultimate solution, I believe, for our economic problems, the panacea for our economic and social ills, lies not only in land use programs, or economic planning, or international trade, or national sufficiency, but to much greater degree, in an advance of the integrity of our national character, a greater measure of personal and collective honesty and unselfishness, a higher ideal of public honesty and unselfishness, a higher ideal of public service, and a broader realization of the brotherhood of man.

W. ELMER EKBLAW

ECONOMIC GEOGRAPHY

A QUARTERLY journal of ECONOMIC GEOGRAPHY published by Clark University for the benefit of geographers, economists, teachers, professional and business men, and all who are interested in the intelligent utilization of the world's resources.

Subscription rates are $5.00 the year in the United States and its Territories; $5.50 the year beyond the borders of the United States, except to charter subscribers.

The January issue of Volume 11 contains the following articles:

Geographical Controls of Agriculture in Orkney and Shetland, Andrew C. O'Dell, Birkbeck College, University of London, England.
Seattle as a Port City, Albert L. Seeman, University of Washington, Seattle, Washington.
Agricultural Regions of Asia: Part VII—The Japanese Empire, Robert Burnett Hall, University of Michigan, Ann Arbor, Michigan.
Human Occupance of the St. Clair Delta, Bert Hudgins, Wayne University, Detroit, Michigan.
Dominica: A Wet Tropical Human Habitat, Lucia Carolyn Harrison, Western State Normal College, Kalamazoo, Michigan.
Rural Settlement in North West Devon, England, Beatrice M. Swainson, Lincoln Training College, Lincoln, England.
Economic Geography of Greece, Joseph Slabey Roucek, Pennsylvania State College, State College, Pennsylvania.
The Rayon Industry in Japan, Shinichi Suzuki, University of Hawaii, Honolulu, Hawaii.

The October issue of Volume 10 contains the following articles:

Agricultural Regions of Asia: Part VII—The Japanese Empire, Robert Burnett Hall, University of Michigan, Ann Arbor, Michigan.
Agricultural Occupation of Hokkaido, D. H. Davis, University of Minnesota, Minneapolis, Minnesota.
Spring and Winter Wheat on the Columbia Plateau, Victor Roterus, State College of Washington, Pullman, Washington.
Geographic Aspects of Coal Cargoes From Toledo, Walter G. Lezius, University of Toledo, Toledo, Ohio.
The Sweet Corn Industry of Maine, Albert S. Carlson and John Weston, Dartmouth College, Hanover, New Hampshire.
Future of Lake Superior Iron Ore Supply, George H. Primmer, State Teachers College, Duluth, Minnesota.
The Los Angeles Harbor Fishing Center, Clifford M. Zierer, University of California, Los Angeles, California.
The Development and Decline of Skagway, Alaska, Edwin J. Foscue, Southern Methodist University, Dallas, Texas.

July includes:

Scottish Carse Agriculture: The Carse of Gowrie, Henry M. Leppard, University of Chicago, Chicago, Illinois.
The Tobacco Growing Industry of North Carolina, Charles E. Landon, Duke University, Durham, North Carolina.
The Structure of Rhine Traffic, Edna E. Eisen, Steuben Junior High School, Milwaukee, Wisconsin.
Land Economy of Warren County, Kentucky: Part III, J. Sullivan Gibson, Kanawha College, Charleston, West Virginia.
Pineapple Industry in Hawaii, John Wesley, Coulter University of Hawaii, Honolulu, Hawaii.
A Geographical Survey for Iowa, George T. Renner, Iowa Forest Survey, Anita, Iowa.
Pine Woods Region of Southeastern Texas, William T. Chambers, Stephen F. Austin, State Teachers College, Nacogdoches, Texas.

April includes:

Agricultural Regions of Asia: Part VI, China, George B. Cressey, Syracuse University, Syracuse, New York.
The Bay Oil Industry of St. John, Earl Shaw, State Normal School, Worcester, Mass.
Location Factor in the Choice of Free Port Sites, S. Axel Anderson, Columbia University, New York, N. Y.
Apple Industry of the Wenatchee Area, Otis W. Freeman, State Normal School, Cheney, Washington.
Markets and Market Areas of East Anglia, Robert E. Dickinson, University of London, England.
Furniture Industry of the Southern Appalachian Piedmont, Ben F. Lemert, Duke University, Durham, North Carolina.
Land Economy of Warren County, Kentucky: Part II, J. Sullivan Gibson, Kanawha College, Charleston, West Virginia.

January includes:

Softwood Resources of Europe, Thorsten Streyffert, College of Forestry, Djursholm, Sweden.
Agricultural Regions of Asia: Part V—India, Samuel Van Valkenburg, Clark University.
The Great Valley of East Tennessee, H. C. Amick, University of Tennessee, Knoxville.
Citrus Fruit Industry of the Los Angeles Basin, Clifford M. Zierer, University of California, Los Angeles.
Land Economy of Warren County, Kentucky, J. Sullivan Gibson, Clark University.
Agricultural Methods on the Canaries, Sören Jensen, University of Copenhagen, Denmark.

The October issue of Volume 9 contains the following articles:

Cereal Production in Turkey, G. Stratil-Sauer, Geographical Institute of Leipzig, Germany.
The California Fruit Industry, Robert W. Hodgson, University of California, Berkeley.
Natural Conditions for Coffee Culture, Olof Jonasson, University of Stockholm, Sweden.
Mining and Tourist Towns in the Canadian Rockies, Stephen B. Jones, Oregon Normal School, Monmouth, Oregon.
Agriculture of Rural England in the Seventeenth Century, G. E. Fussell, Ministry of Agriculture and Fisheries of Great Britain, London.
Ryukyu Islands, Japan, Yukuo Uyehara, University of Hawaii, Honolulu.
The Central Highway of Cuba, Edwin J. Foscue, Southern Methodist University, Dallas, Texas.
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ANNOUNCEMENT

IN THE July issue of ECONOMIC GEOGRAPHY Dr. Samuel Van Valkenburg will continue the *Agricultural Regions of Asia*. In later issues Dr. Homer L. Shantz, President of the University of Arizona, will contribute his series on *Agricultural Regions of Africa* which, upon conclusion, will complete the finest geographic discussion of the world's agriculture thus far established.

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